STEEL SQUARE POCKET BOOK

STODDARD

C. S. LORN
HARDWARE & TOOL CO.
615 MARKET ST.
SAN FRANCISCO, CAL.

J M Day

THE STEEL SQUARE POCKET BOOK

A Practical and Handy Treatise Giving the Best Methods of Using the Carpenter's Steel Square

BY

DWIGHT L. STODDARD

SECOND EDITION. REVISED AND ENLARGED

PHILADELPHIA
DAVID McKAY, Publisher
610 South Washington Square
1906

Copyright Secured
1904 and 1906
By Charles G. Peker

PREFACE.

Many years ago, to answer a correspondent, I wrote an article for *Carpentry and Building*. Since then, from time to time, I have been requested to write, until I have written many articles on the Square that have been published by the leading publications and are of particular interest to the carpenter. Carpenters from time to time have requested me to put them in book form; but realizing that so much had been written on the subject, I at first thought there was not much real need for any more publications, but I find, after all, that there is very little, indeed, on the subject that is in plain, convenient, neat and handy form for the everyday use of the mechanic.

In this little book I try to present to the world, in plain language and illustrations, the way I use my own square in my daily work. If I succeed in making it so plain that they who read can apply, and make life easier, pleasanter and more valuable for those that own this little book, I shall be well paid for my efforts.

DWIGHT L. STODDARD.

Indianapolis, 1904.

PREFACE TO SECOND EDITION.

The fact that the first edition of my little book has become exhausted much more quickly than I had expected gives me great encouragement to strive to improve this new edition and make it an even more valuable every-day reference book than the previous one.

To this end the entire book has been re-arranged, many parts re-written and considerable new matter added, including some 40 new illustrations.

The many kind words of praise I have received from all parts of the country leads me to believe that I did fairly well for my first effort, and if this improved edition meets with the same success in benefiting thousands of carpenters, it will fulfill the wish of

THE AUTHOR.

Indianapolis, August 1906.

INTRODUCTION.

A quarter of a century ago, although mechanics worked longer days than to-day, yet they seemed to have plenty of time to walk, or ride with an ox team to their work. And they thought they were going at a great speed if they rode in a car drawn by a mule. But to-day they must go at breakneck speed on a bicycle, automobile, or as fast as electricity can carry them.

They used to work by the day; now they work by the hour, and the time seems near when they will work by the minute, and every *minute* must *count.*

This is indeed the day of electricity and instantaneous applications, and the square is the only method I know of that fully fills those requirements for the carpenter.

Many times very nice illustrations are explained by the A B C method, but the average mechanic won't take time to hunt them through from A to Z.

Therefore in this little book I have endeavored to make illustrations that can be grasped at a glance and applied instantly and not a minute lost figuring it out.

It is not my aim to tell all that can be done with the square—only a very small part. I shall endeavor to illustrate only the practical, everyday uses in as brief a manner as possible, believing that when the student has mastered all the fundamental principles of the square given in this little book, he will be a master of the square, and with it can master any practical proposition with which he may come in contact.

I here present my methods of applying the square, many of which, as well as the illustrations are original, and I don't know of another person using them, though as the square has been used for ages, it is possible that every principle I illustrate here was used by man many thousands of years ago. However, this is not very probable.

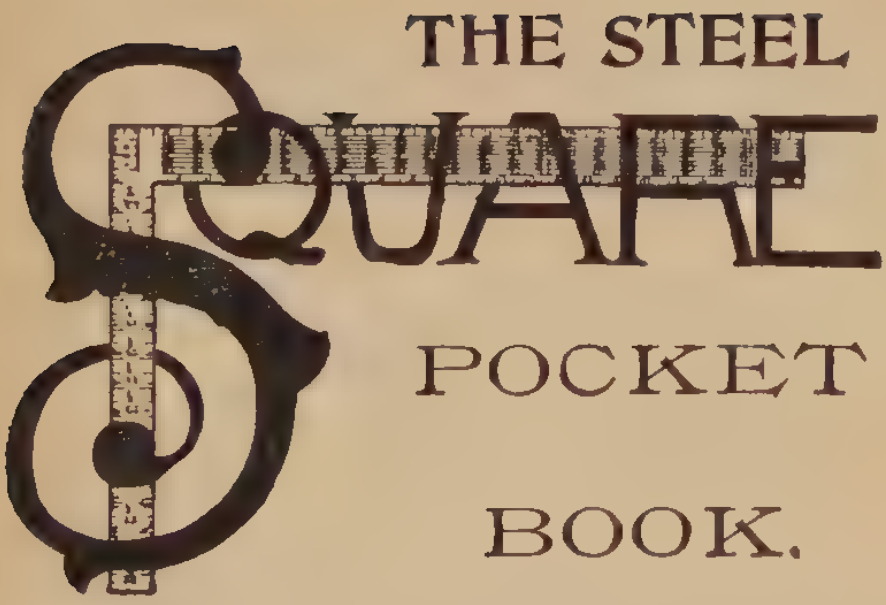


Fig. 1. The square illustrated above is my old square—the kind that has been recognized as standard for many years past, and probably will be for many to come. It is a Number 100, and has a blade two feet long by two inches wide, and a tongue 18 inches long by one and one-half inches wide. While that is the standard full-size square, the tongue may be cut off from one to six inches to suit the wishes of the individual mechanic. And by consulting the catalogues of the different

manufacturers it will be found that there are many different sized squares made to suit the many different trades.

Fig. 2. The little one foot long by one and one-half inches wide blade, and

FIG. 2. SMALL SQUARE.

eight inches long by one inch wide tongue, is one of the handiest tools a carpenter can carry; yet it does not take the place of the larger square.

Fig. 3. One side of the square is divided into sixteenths of an inch on the outer edge, and eighths on the inner, and is figured to read from the corner

(which is called the heel) to the ends, and therefore one side reads from left to right and the other side from right to left. A center row of figures runs

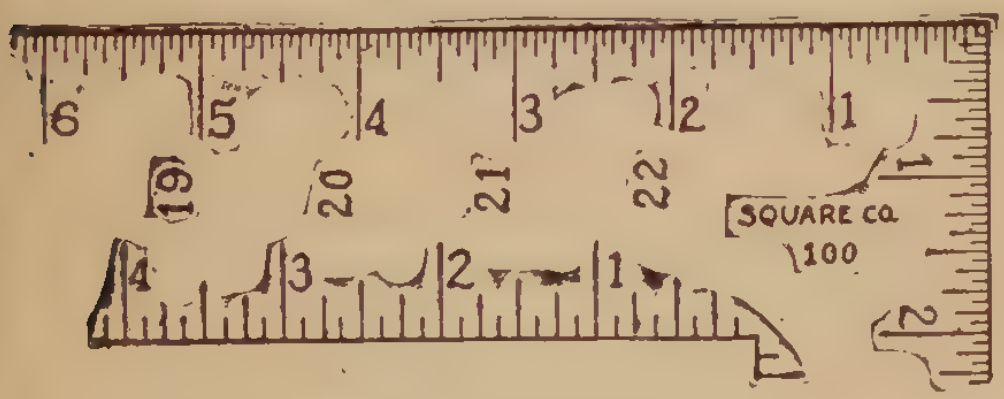


FIG. 3. THE SQUARE.

along the blade that reads from left to right. The name of the manufacturer and the catalogue number are generally stamped on the corner.

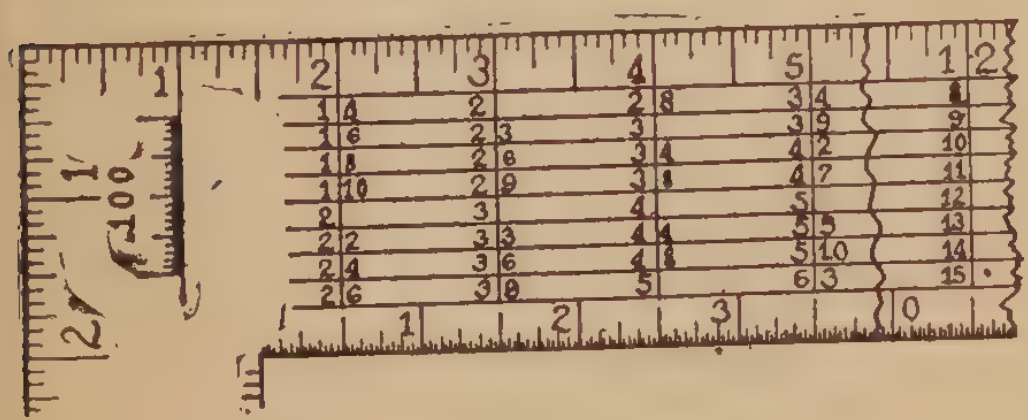


FIG. 4. BOARD MEASURE.

Fig. 4. The other side of the blade is divided into twelfths on the outer

edge and thirty-seconds on inner. An inch in the corner is divided into hundredths. The great mass of the figures on the face of the blade is board measure, which is used as follows:

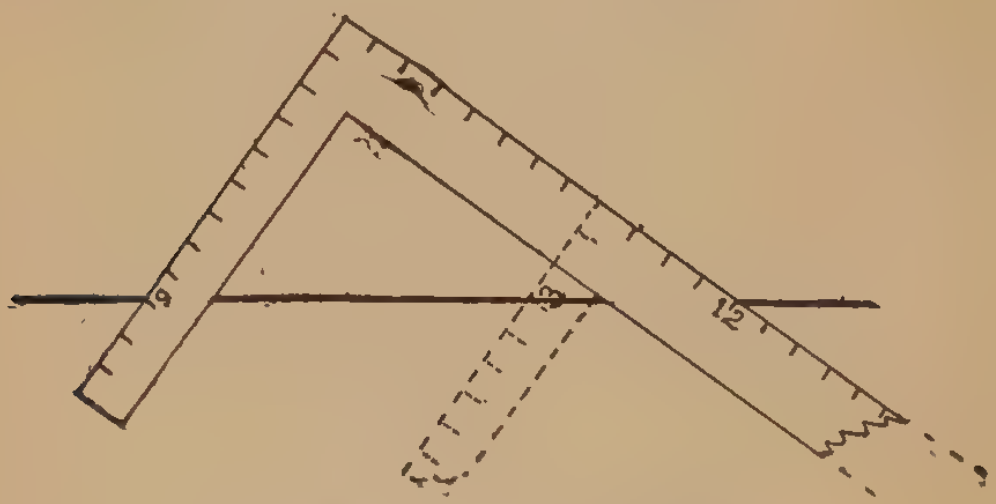


FIG. 5. BOARD MEASURE.

Under twelve on the square find the length of board, and follow that line

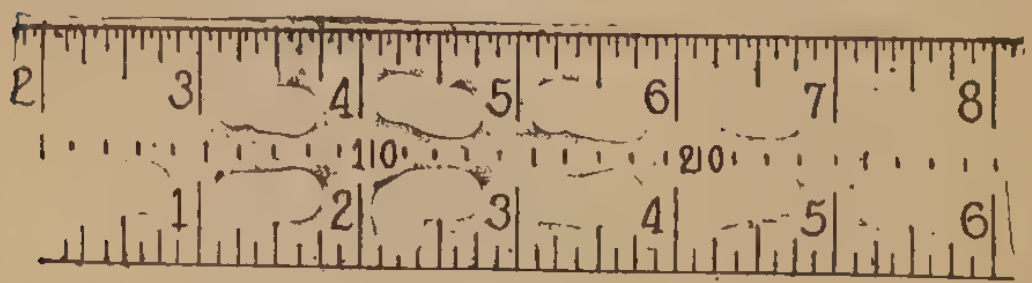


FIG. 6. OCTAGON SCALE.

along to the width of board, and there will be the number of feet in the board.

For a board 9 feet long and 4 inches

wide, you find 9 under 12 on square in second row; follow that along to 4 inches width of board, and the answer is 3; 3 is in second row under 4 inches on the square, therefore there are three square feet in the board.

Fig. 5. Shows another method. Take 12 on the blade and 9 on tongue (length of board), and bring 12 down to 4 inches (width of board), and it gives 3 on the tongue, which is also the answer.

Fig. 6. The small figures, 10, 20, 30, etc., in center of tongue are for laying off octagons.

From the center of the timber measure off the number corresponding with the width of timber, which gives corner of octagon.

Fig. 7. From the center of a 10-inch timber to the little 10 on tongue is where to cut the timber to make it an octagon.

Fig. 8. Lay the blade of the square across diagonally and mark at 7 and 17,

and it gives it practically as accurate, although the measurement may be about a sixteenth of an inch too much;

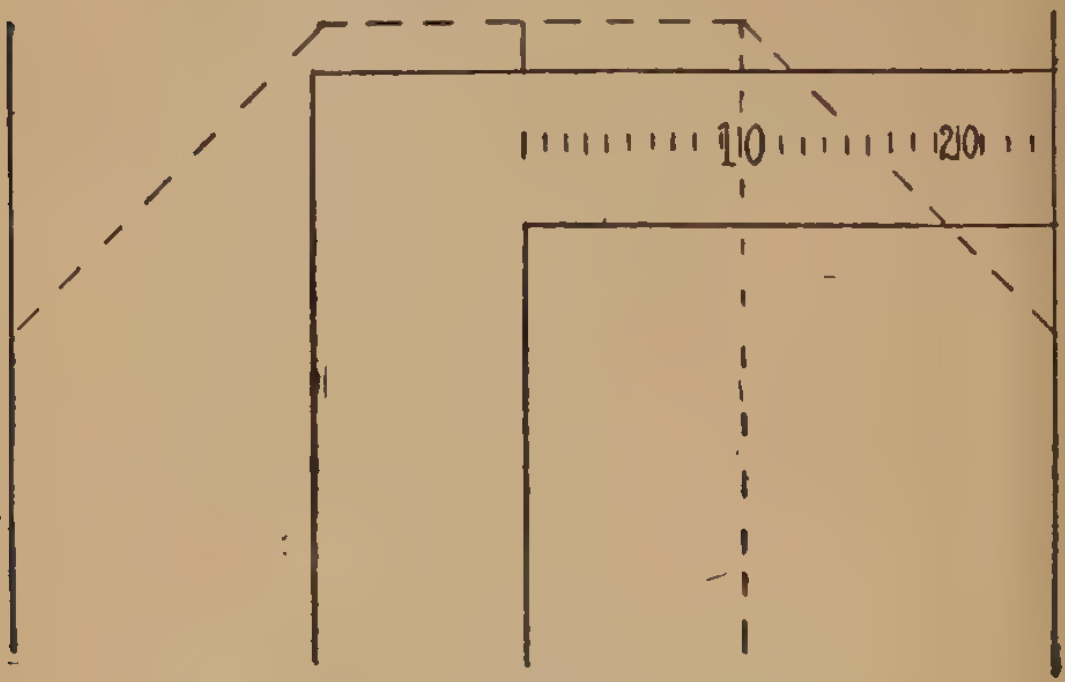


FIG. 7. OCTAGON SCALE.

a sixteenth of an inch, if measured very diagonally, is indeed a very small meas-

FIG. 8. OCTAGON.

urement, and is accurate enough for any purpose I ever had occasion to use.

Fig. 9. Or take the end of the timber (or an octagonal house, either); measure the width across the diagonal

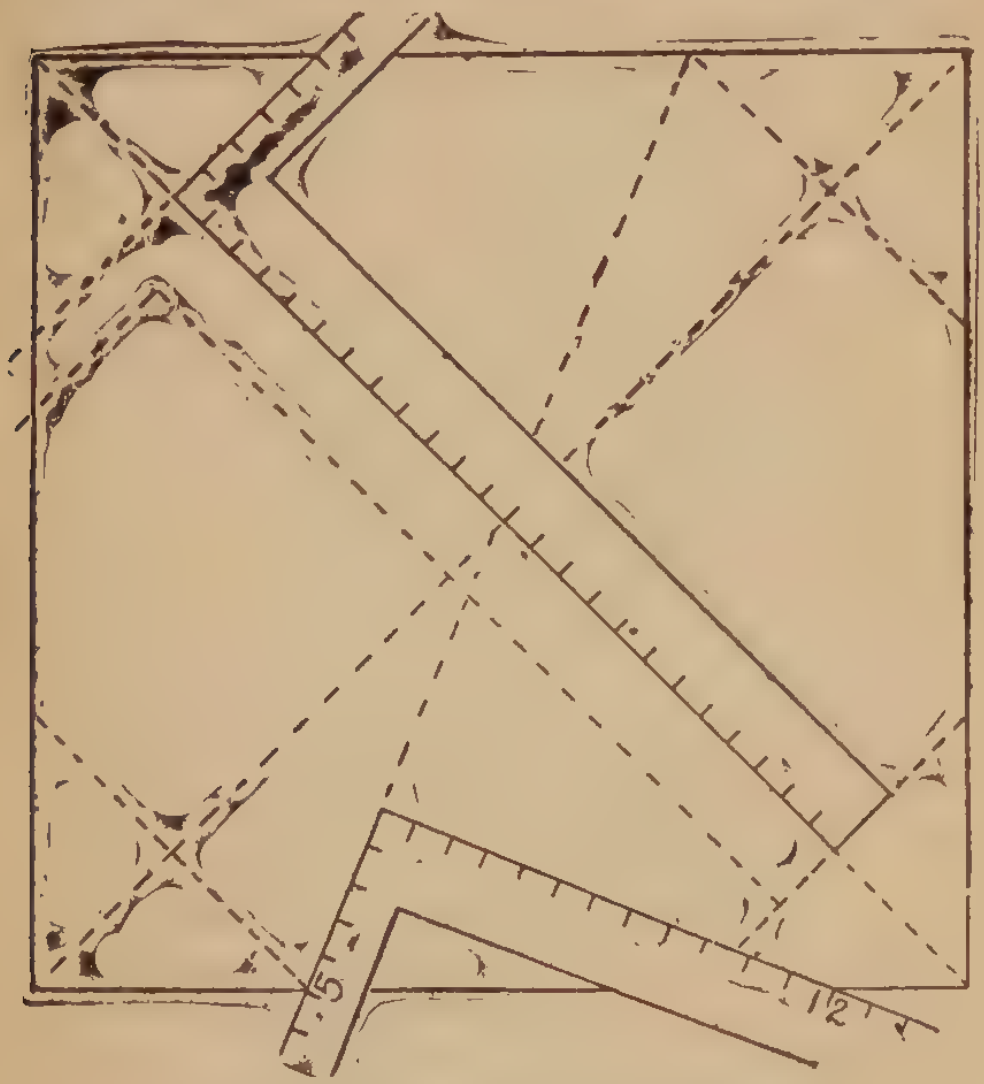


FIG 9. LAYING OFF OCTAGON.

and it gives it. This is a very simple and accurate way to lay off an octagon figure. Also 5 and 12, cut on 5, is an octagon cut, commonly called octagon

miter (though an angle of 45 degrees, or a square put together that way, is the only cut to be called a *miter* by old standard authorities; but I think the custom of the mechanic of to-day recognizes any intersecting angle as a miter about as much as the 45-degree angle, and we use the expression of polygons and their miters just the same as squares and their miters; in fact, there seems to be no word that fits all angles as well). 12 and 12 (or square miter) is octagon corner.

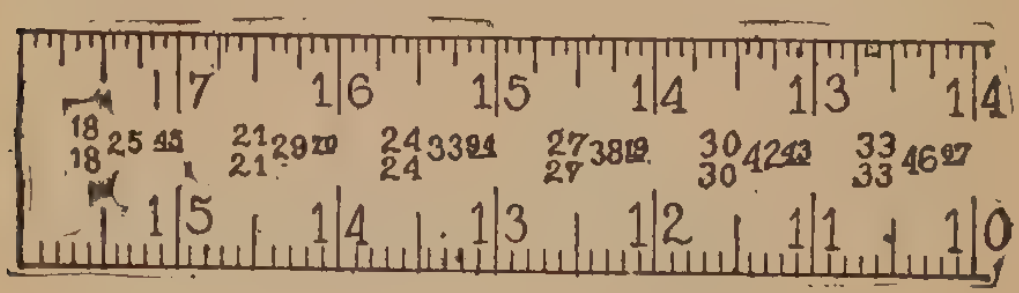


FIG. 10. BRACE MEASURE.

Fig. 10. The small figures in the center of the other side of the tongue is brace measure. Thus:

18

25.45

18

means a brace having a run of 18 and rise of 18; its length is 25.45.

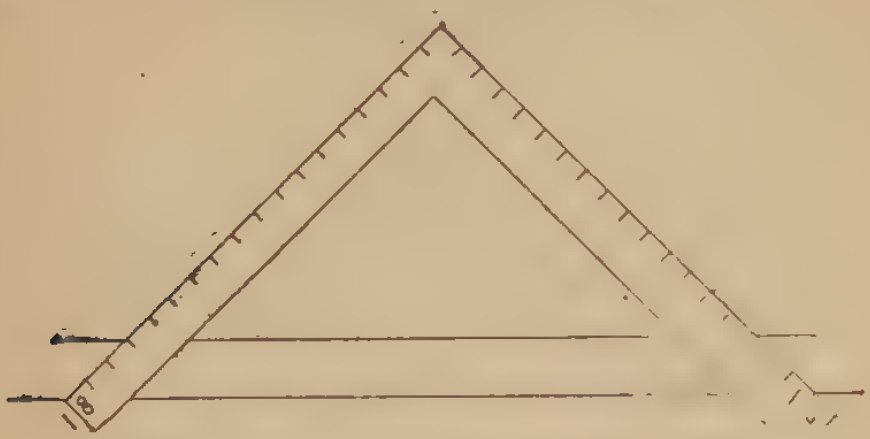


FIG. 11. BRACE MEASUREMENTS.

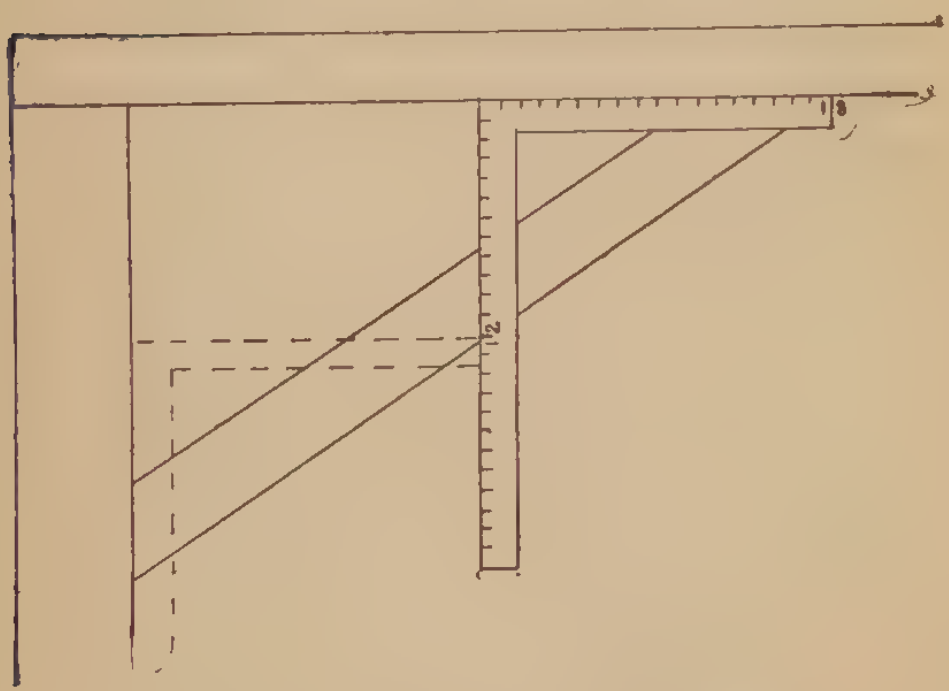


FIG. 12. LAYING OFF BRACES.

Fig. 11. Place the square at 18 on blade and 18 on tongue, and it gives length and cuts, which is much simpler

than the brace measurement given on the square.

Fig. 12. For a brace rising 2 feet and running 3 feet, place the square on 12 and 18 twice, and it gives the length and cuts.

Fig. 13. For a long brace running 16 feet and rising 12 feet, measure

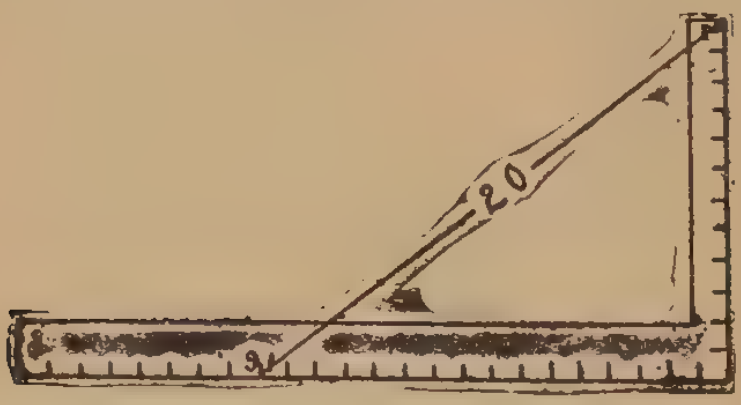


FIG. 13. GETTING BRACE MEASUREMENTS.

across the square from 16 inches to 12 inches, and the result is 20 inches. If the diagonal of 16 inches and 12 inches is 20 inches, of course the diagonal of 16 feet and 12 feet is 20 feet, which is length of brace.

Fig. 14. Illustrates a square that has been put on the market since the one just mentioned and will, perhaps, take

the place of it as it gives Rafter instead of Board Measure, and is therefore of more value to the ordinary carpenter.

The first line gives length of common rafter per foot of run, the figures appear under each figure from 18 down to 2.

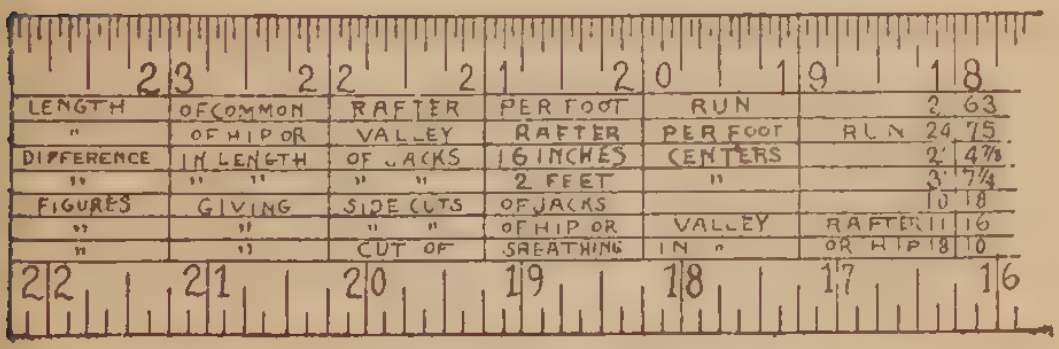

LENGTH OF COMMON RAFTER PER FOOT RUN
" OF HIP OR VALLEY RAFTER PER FOOT RUN 24 75
DIFFERENCE IN LENGTH OF JACKS 16 INCHES CENTERS 2' 4⅞
" " " " 2 FEET " 3' 7¼
FIGURES GIVING SIDE CUTS OF JACKS 10 18
" " " " OF HIP OR VALLEY RAFTER 11 16
" " CUT OF SHEATHING IN " OR HIP 18 10
2 3 2 2 2 1 2 0 1 9 1 8
2 2 2 1 2 0 1 9 1 8 1 7 1 6

FIG. 14. RAFTER MEASUREMENTS.

The second line gives length of hip or valley rafter per foot of run.

The third line gives difference in length of jacks 16 inches on centers.

The fourth line gives difference in length of jacks 2 feet centers.

The fifth line gives figures giving side cut of jacks.

The sixth line gives figures giving cut of sheathing in valley or hip.

While these are all very handy, especially when they are in even feet, yet when they are not, it makes a somewhat complicated job of figuring as does all these tables, whether they are given on the square, in charts, keys or any other way.

The manufacturer of this Square not only had the idea of making a square of more practical value to the roof framer but to all other framers as well, and as the day of dressed lumber is at hand and makes the 2-inch stuff only about 1¾ inches they thought the mechanic would appreciate a 1¾-inch tongue on their square, but they undoubtedly did not realize the fact that the real mechanic uses the tongue of his square to do most of his laying off, and the blade to do the marking, therefore the 1¾ tongue was not the success that it might at first been expected.

Fig. 15. As lath are 4 feet long, and as a studding has to be at each end and

two in the middle, it makes the studding 16-inch centers, and many car-

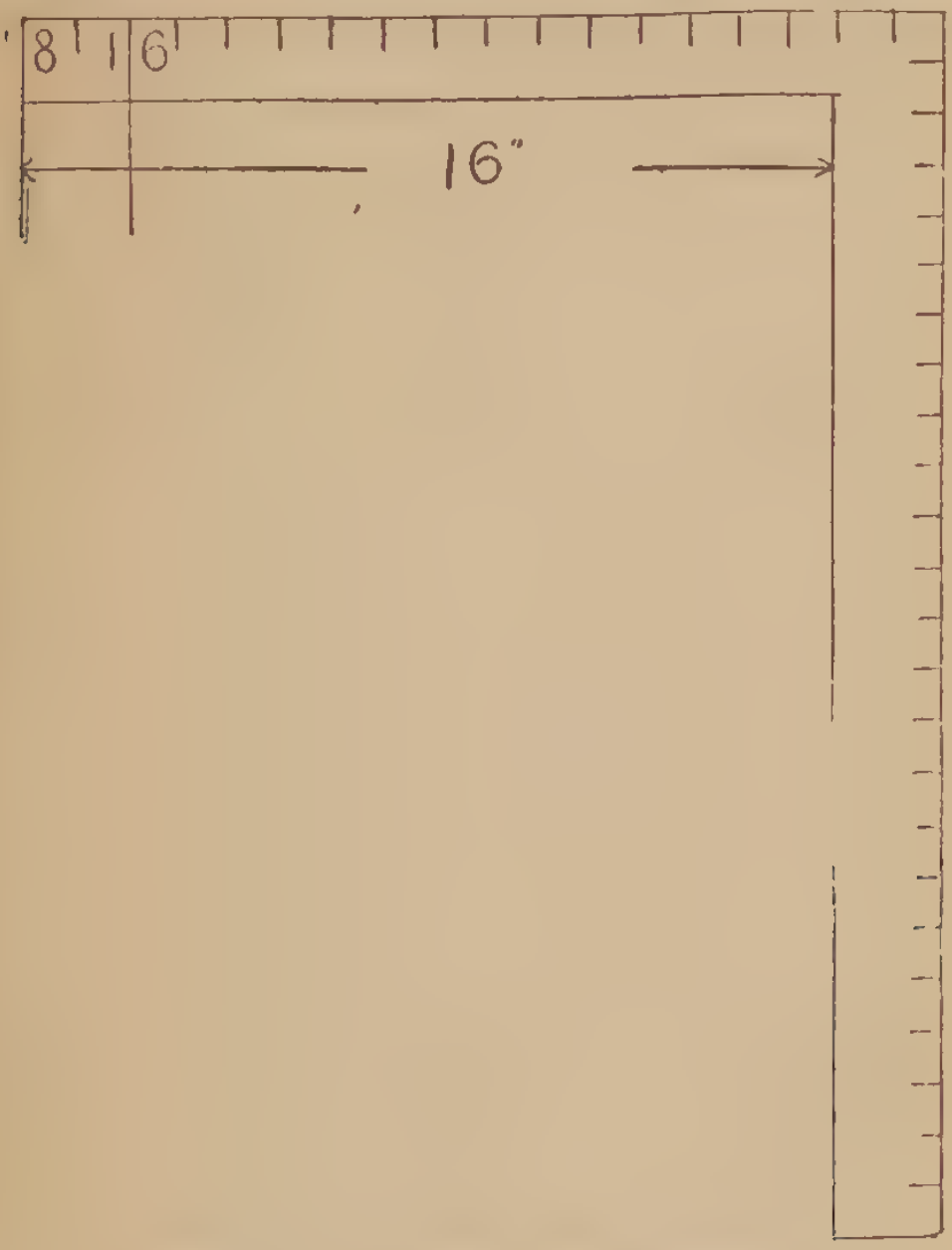


FIG. 15. SPACING STUDDING.

penters think they must have a 16-inch tongue to lay off studding. Place the end of 18-inch tongue to left line, and

it's just as easy as placing 16-inch tongue to right line.

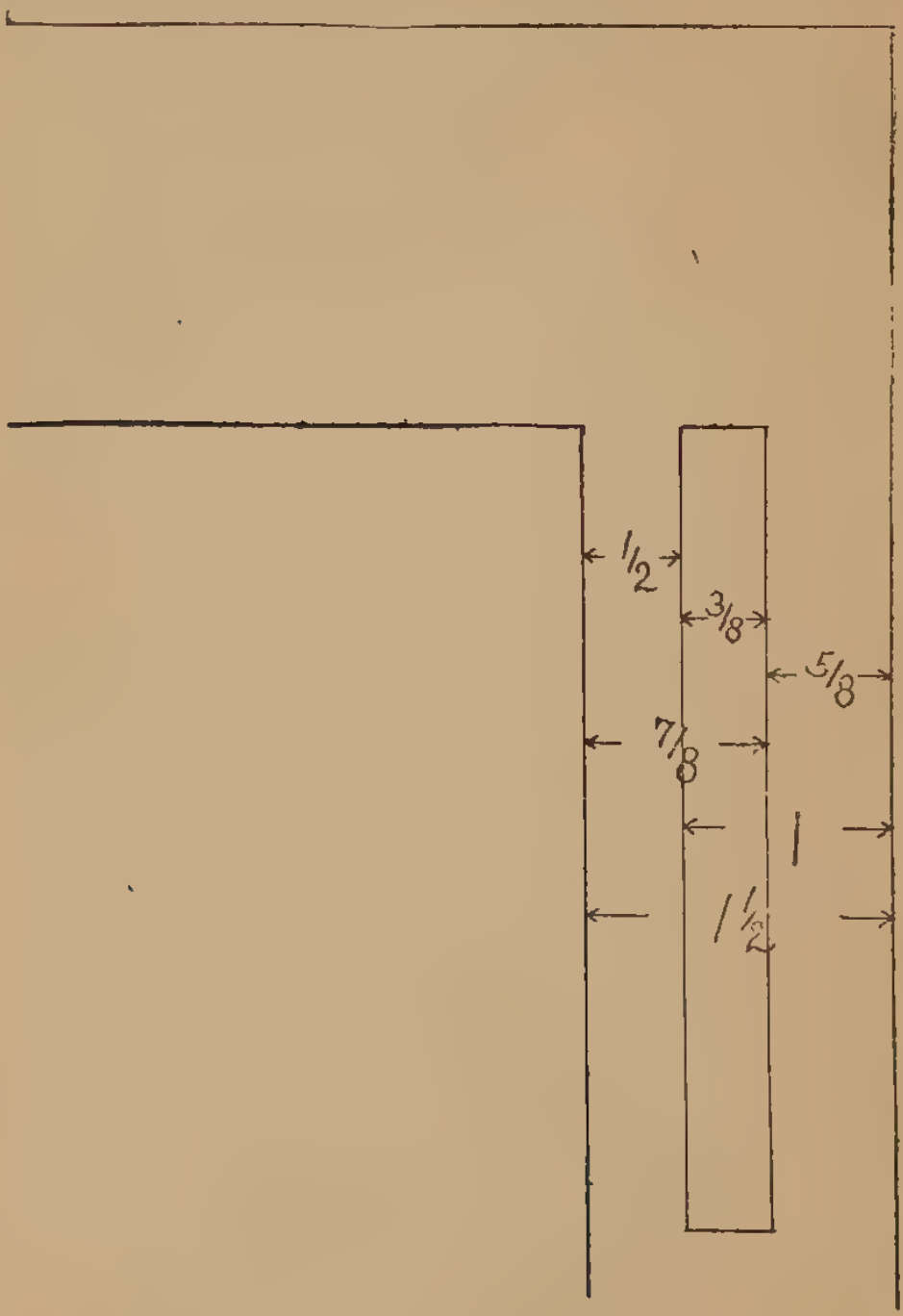


FIG. 16. THE 4-INCH SLOT.

Fig. 16. The square with either 18-inch or 16-inch tongue is the most un-

handy tool the carpenter of to-day has to contend with. The day of big chests and large kits of tools is fast passing away. To meet the demand the folding square and many other inventions have been thought of, but nothing to my knowledge has come as near filling the requirements as my 12-inch tongue with 3/8x4-inch slot.

This square I made out of a common square by cutting off the tongue and cutting out the slot; while this square is not on the market, it is well worth any carpenter's time to be machinist long enough to make one. It has spaces of 3/8, 1/2, 5/8, 7/8, 1, and 1 1/2 inches, and by putting these measurements together there is no end to the rapid measurements that can be had.

Fig. 17. Place the end of 12-inch tongue at left mark (same as 18-inch tongue), and make a scratch at right edge of blade, and move square up to left edge of slot, and it spaces studding nearly as handy as 16-inch or 18-inch

tongue. Or put end of square at right mark (same as 16-inch tongue), put

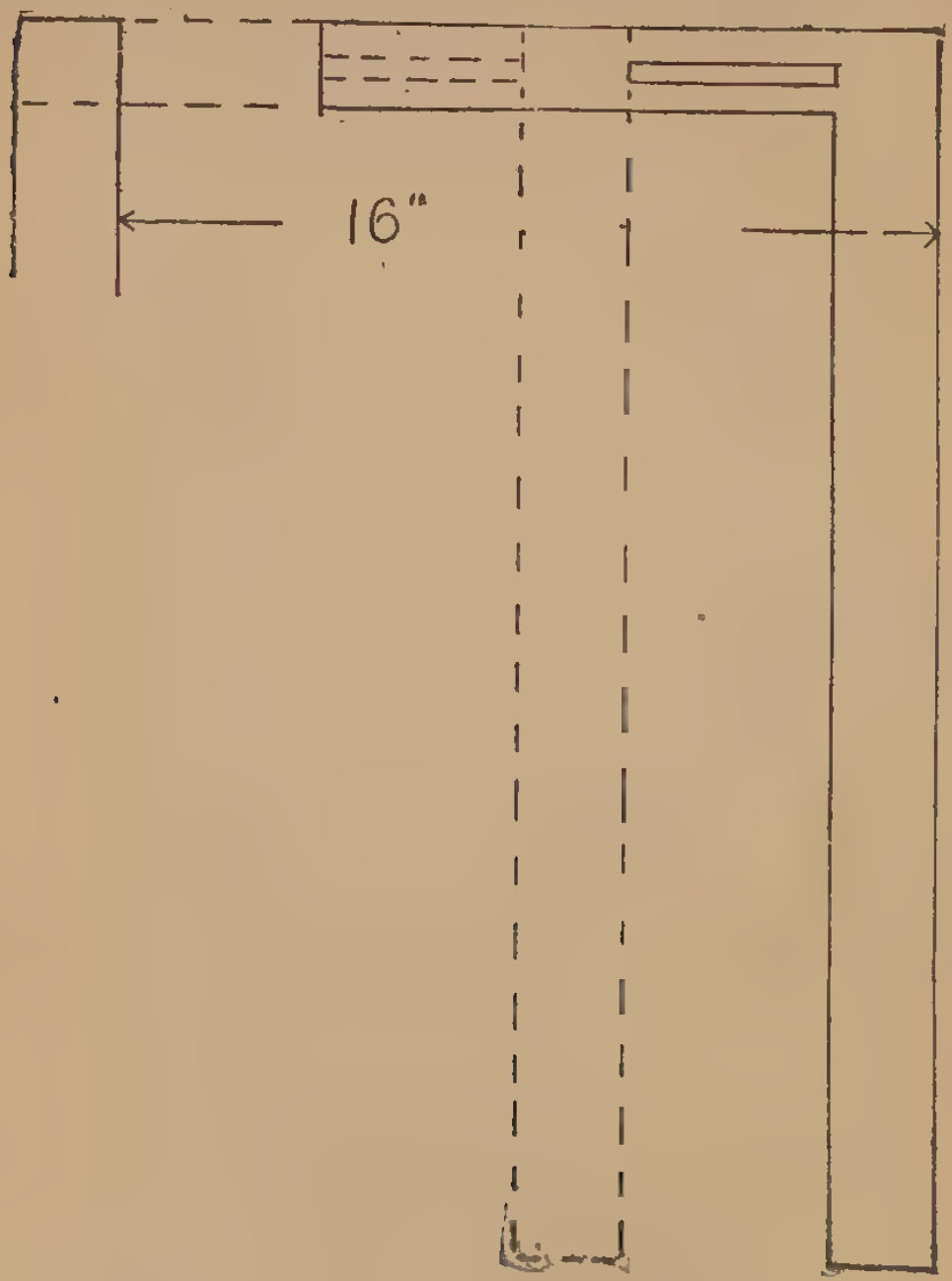


FIG. 17. SPACING WITH SLOT.

pencil (or awl) at right end of slot and move square up to left end, and it also spaces the 16 inches as illustrated.

Fig. 18. For 10-inch centers, place square at left mark; at right mark for 12; 10 applied twice for 20; 10 and

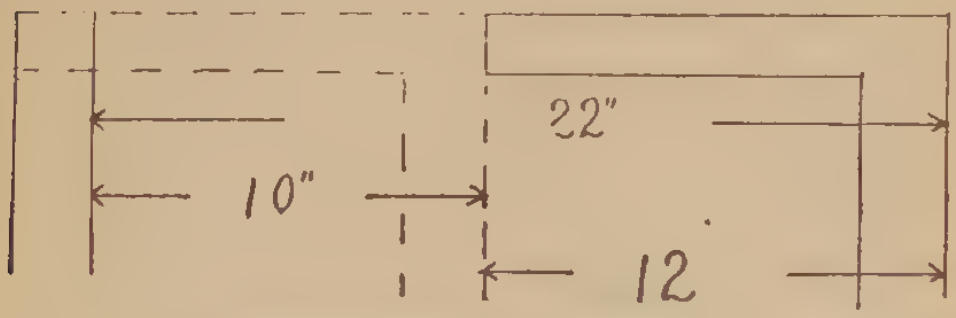


FIG. 18. SPACING WITH 12-INCH TONGUE.

12 for 22; 12 twice for 24, etc. Any even space can be applied instantly, without any reference whatever to the figures on the square.

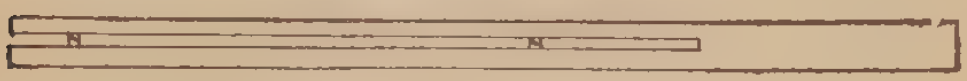


FIG. 19. FENCE.

Fig. 19. Saw a slot in a stick, put two screws in it and screw it to the square, this is called "a fence" and it makes a very handy guide for laying off stairs, etc.

Fig. 20. Measure the height from top of first floor to top of second floor; find the number of risers it will take

(7 to 7½ inches makes a very easy stair); then get the width of treads, re-

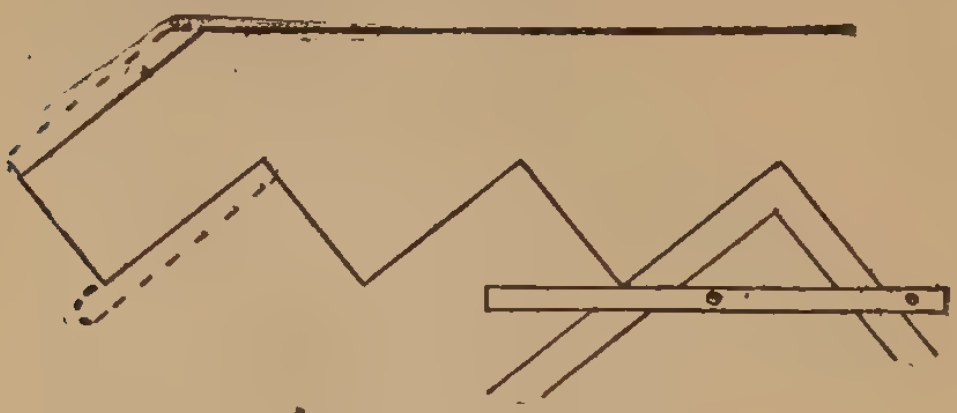


FIG. 20. STAIRS.

membering that there is one less tread

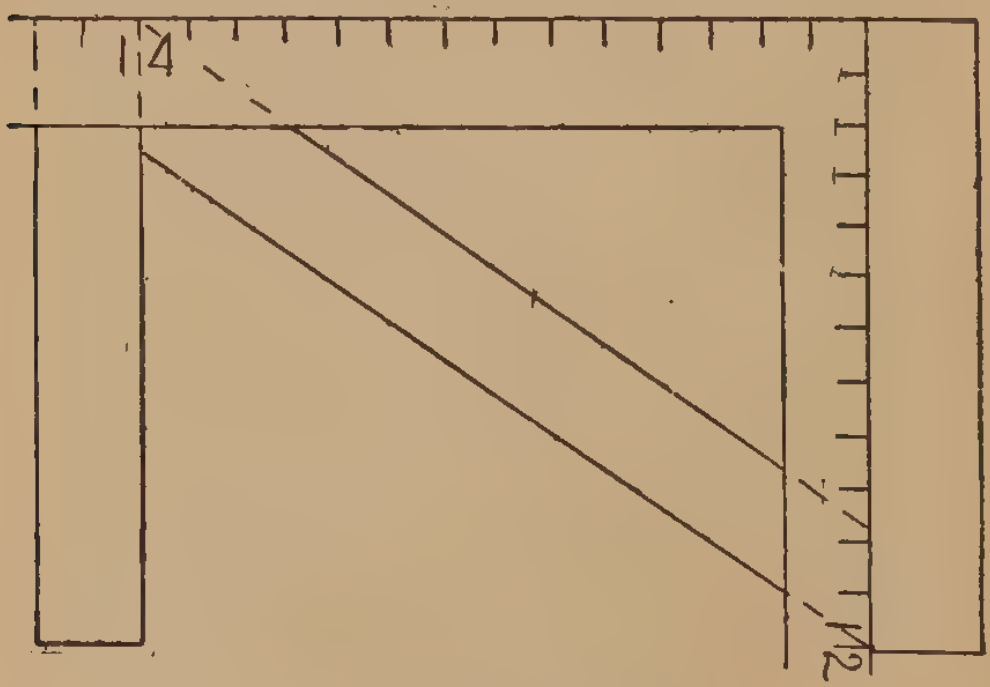


FIG. 21. BRIDGING.

than riser, as the floor makes one tread. Take the measurements found and lay

off the stair; cut the thickness of tread off from the bottom.

Fig. 21. Take the distance between joist on one side of the stick and the width of joist on the other; cut on width for bridging.

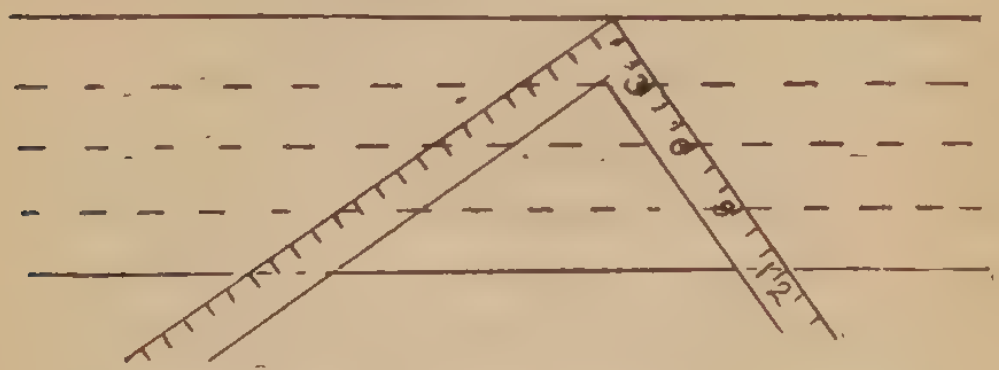


FIG. 22. DIVIDING IN EQUAL PARTS.

Fig. 22. To divide anything into an equal number of parts sometimes makes very complicated fractions, but the square can overcome such little things. To divide a 10-inch board into four equal parts, place the square across the 12-inch and mark at 3, 6, 9, and it gives it accurately and no fraction to bother with.

Fig. 23. To lay off a leg for a trestle two feet high and have the legs sixteen

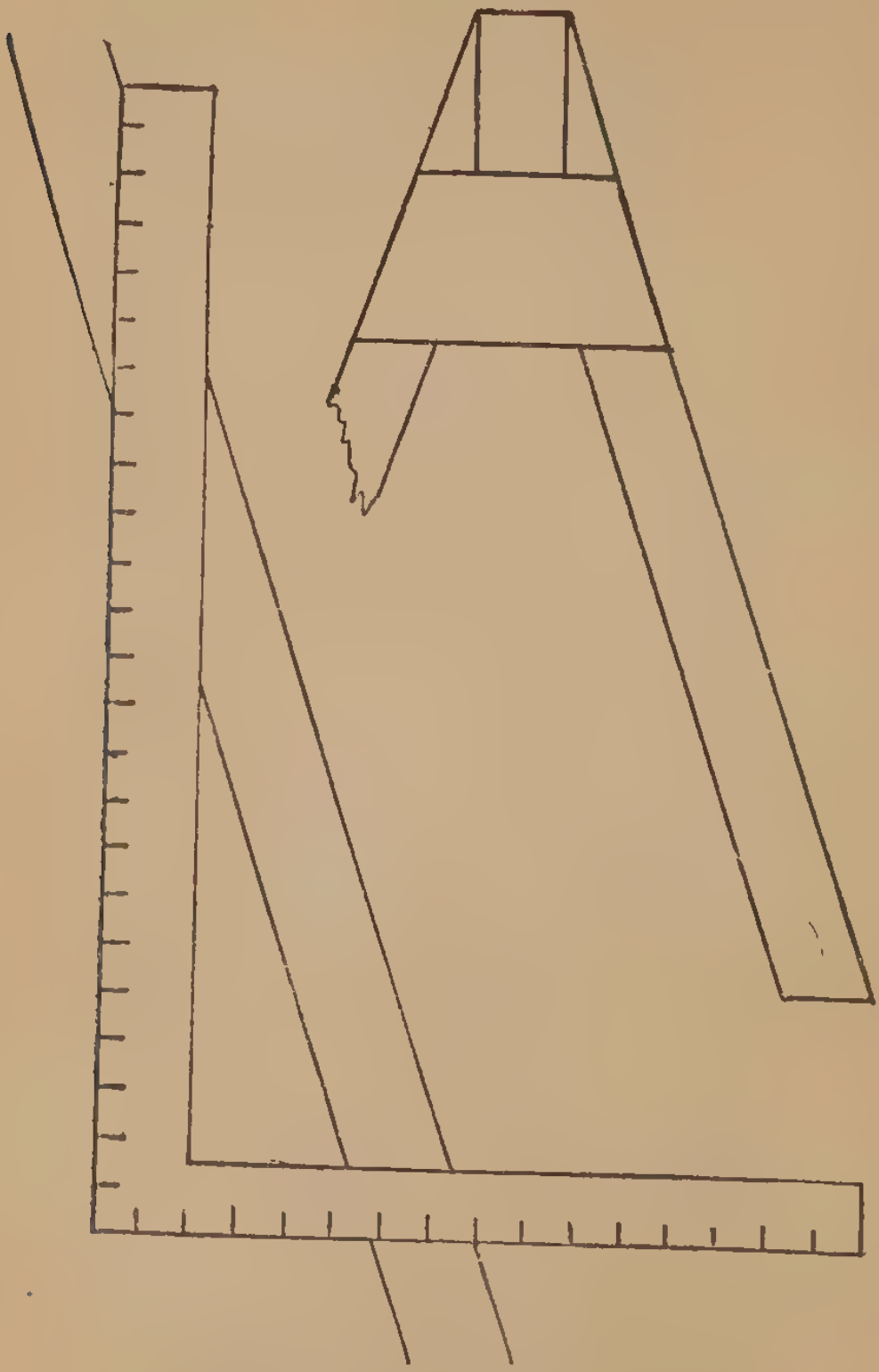


FIG. 23. LAYING OUT TRESTLE.

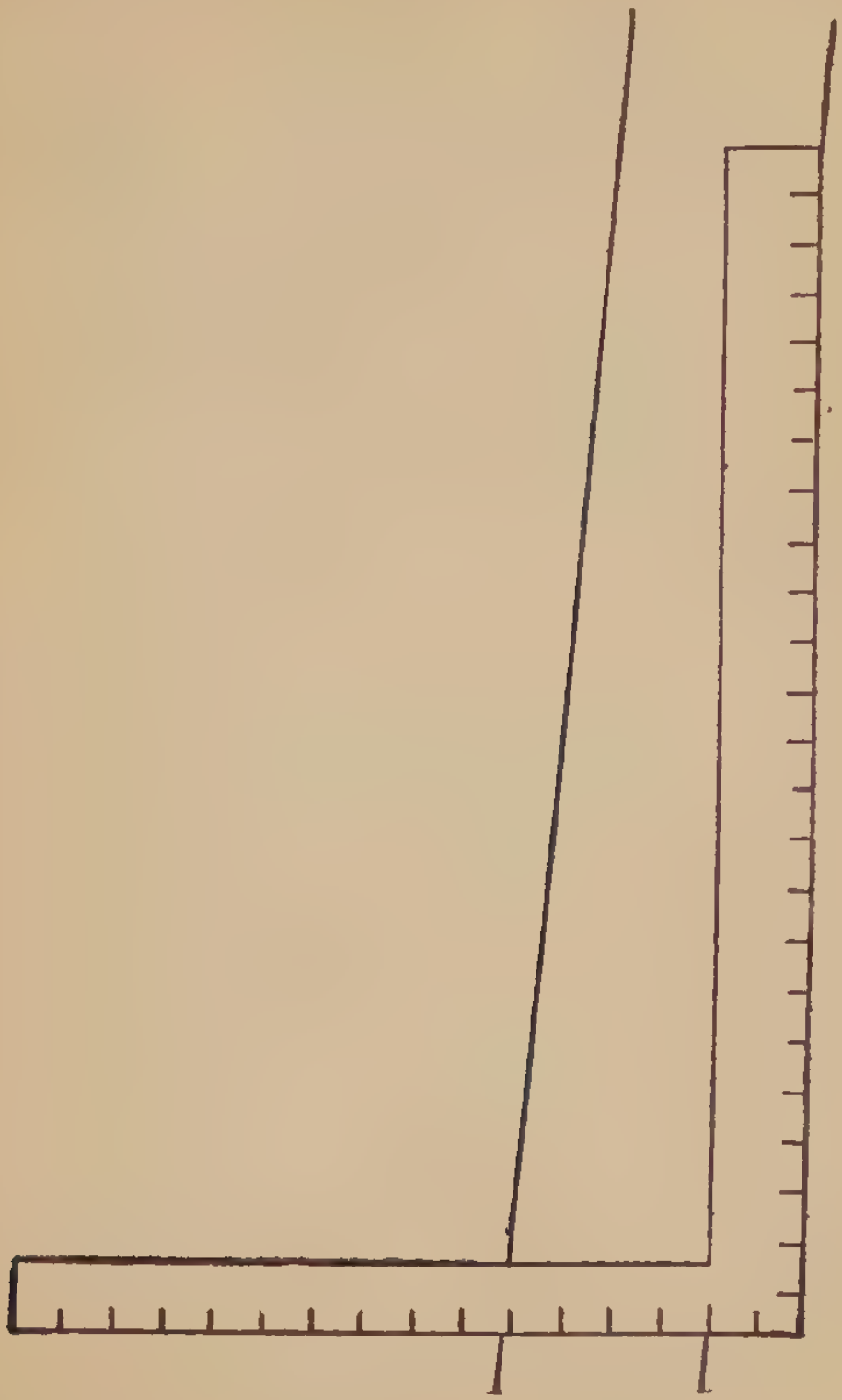


FIG. 24. OTHER CUT OF TRESTLE LEG.

inches from center to center of bottom of legs.

Place the end of blade of two feet square for top end and at eight inches on the tongue for bottom, which gives length and edge cut of leg.

Fig. 24. If you wish the leg to be two inches nearer the end of trestle at

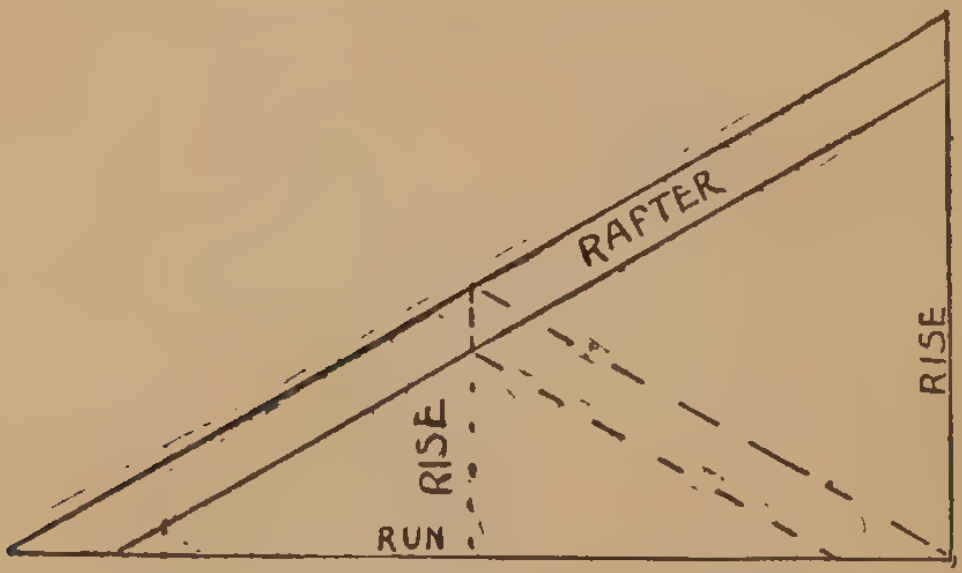


FIG. 25. RISE, RUN AND RAFTER.

bottom than at top, place the square on 2 inches, or in other words, place the out edge of blade at bottom and inner edge of blade at top, as illustrated.

Fig. 25. When we get to the roof there are three more R's to consider—

Run, Rise, and Rafter. A shed roof has a run the width of the building; a gable roof the run is one-half the width of the building.

Fig. 26. If we were building a house 4 feet square and wanted to have a shed roof with two-foot rise.

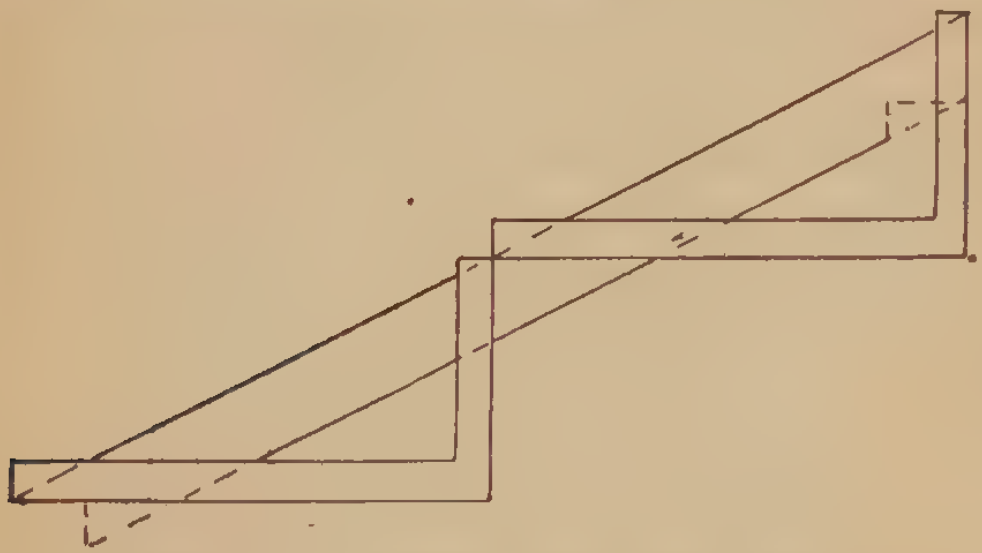


FIG. 26. LAYING OUT RAFTERS.

Place a 12-inch tongue square on twice and it gives length of rafter and cuts.

Fig. 27. Should we want a gable roof instead of shed, and wish it to rise 16-inch to 2 feet run (or ⅓ pitch), take the full length of a 16-inch tongue square and it gives the length of rafter and cuts.

Fig. 28. To make an oval seat for inside of the house 9 by 11 inches, drive

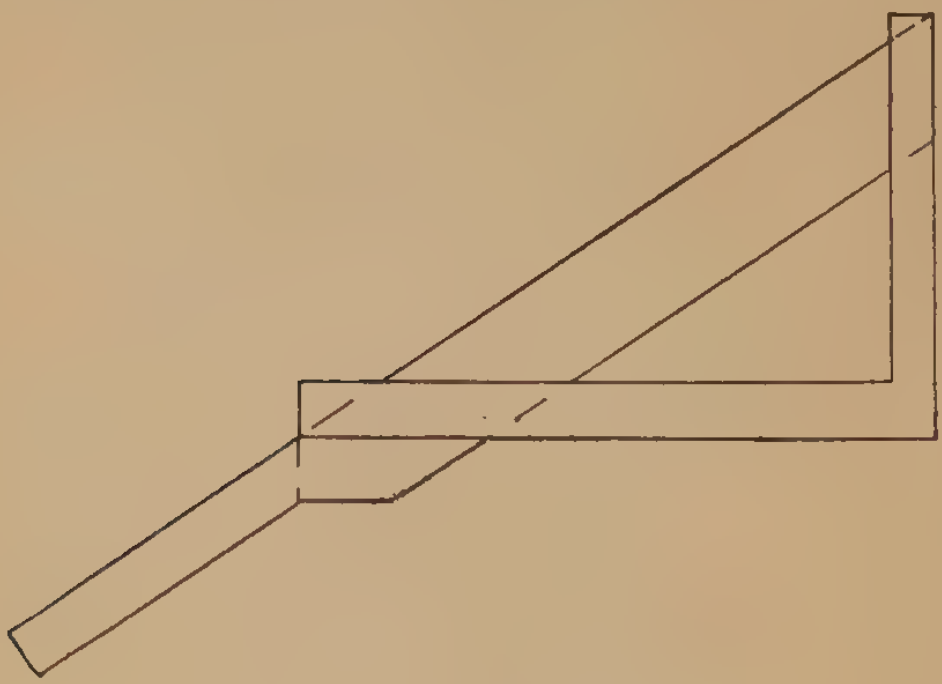


FIG. 27. RAFTER.

two nails 9 inches apart and one on the other side of the square at 11 inches.

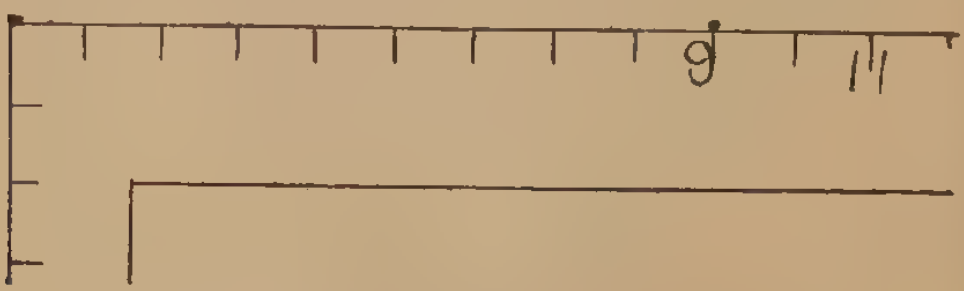


FIG. 28. MEASUREMENTS FOR OVAL.

Fig. 29. Place pencil in corner of square, move it around, and it will give

one-half of oval; reverse square and 11-inch nail and produce the other half the same way.

Fig. 30. Pitches of roofs and degrees of pitches are subjects well worth a little serious thought and study. This

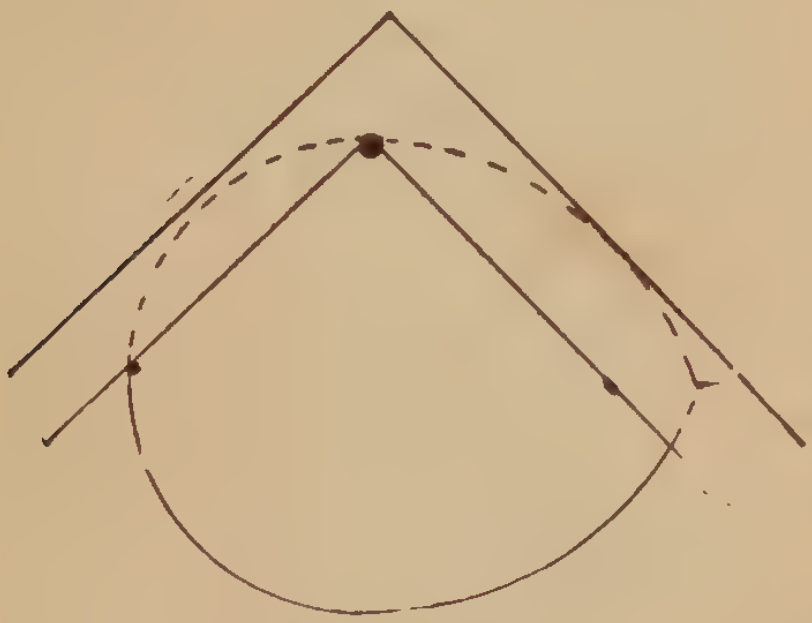


FIG. 29. OVAL.

illustration will be convenient to refer to a good many times.

Fig. 31. Plan of roof for house 20 feet by 28 feet. Main part hip roof, ⅓ pitch, front gable ⅔ pitch, which is very properly called uneven pitch roof.

Fig. 32. Elevation showing how the

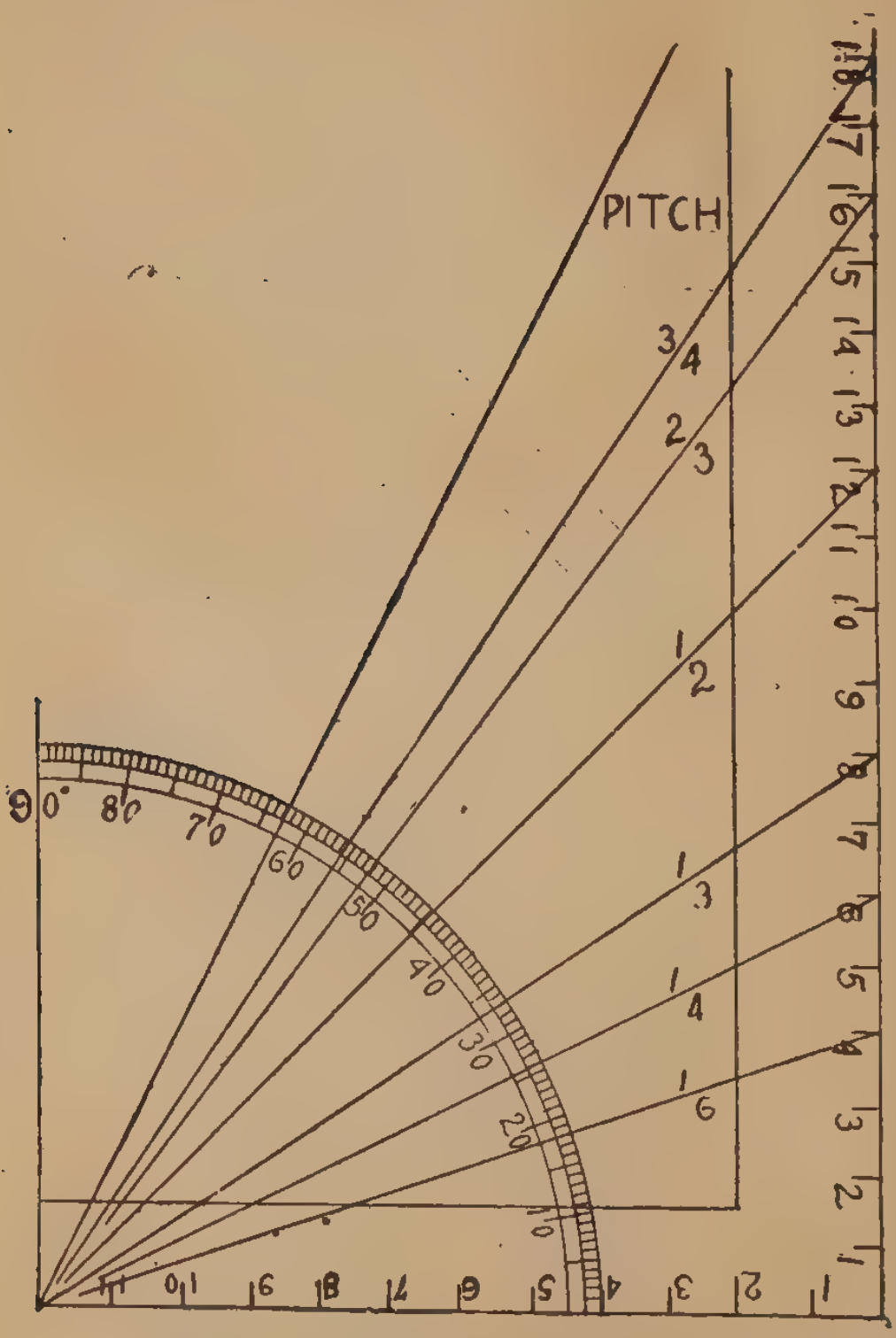


FIG. 30. DEGREES AND PITCHES.

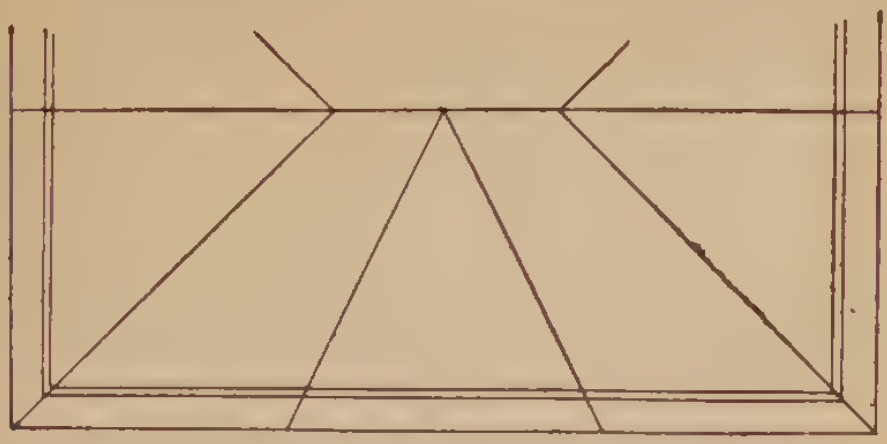


FIG. 31. PLAN OF ROOF.

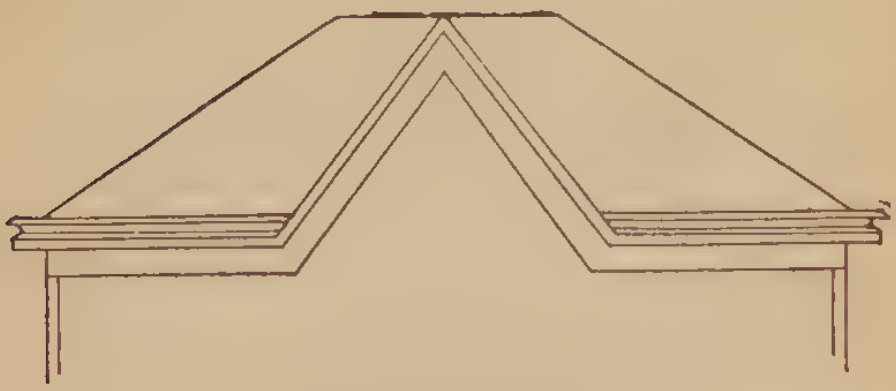


FIG. 32. ELEVATION.

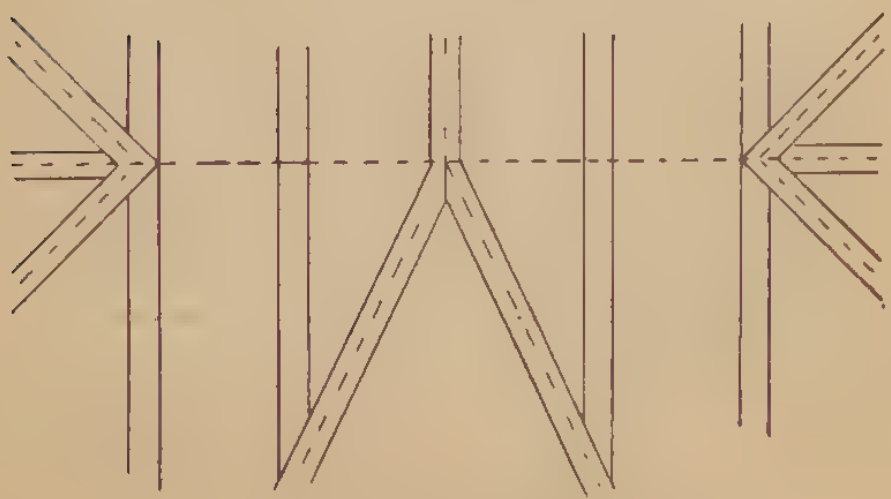


FIG. 33. CONSTRUCTION.

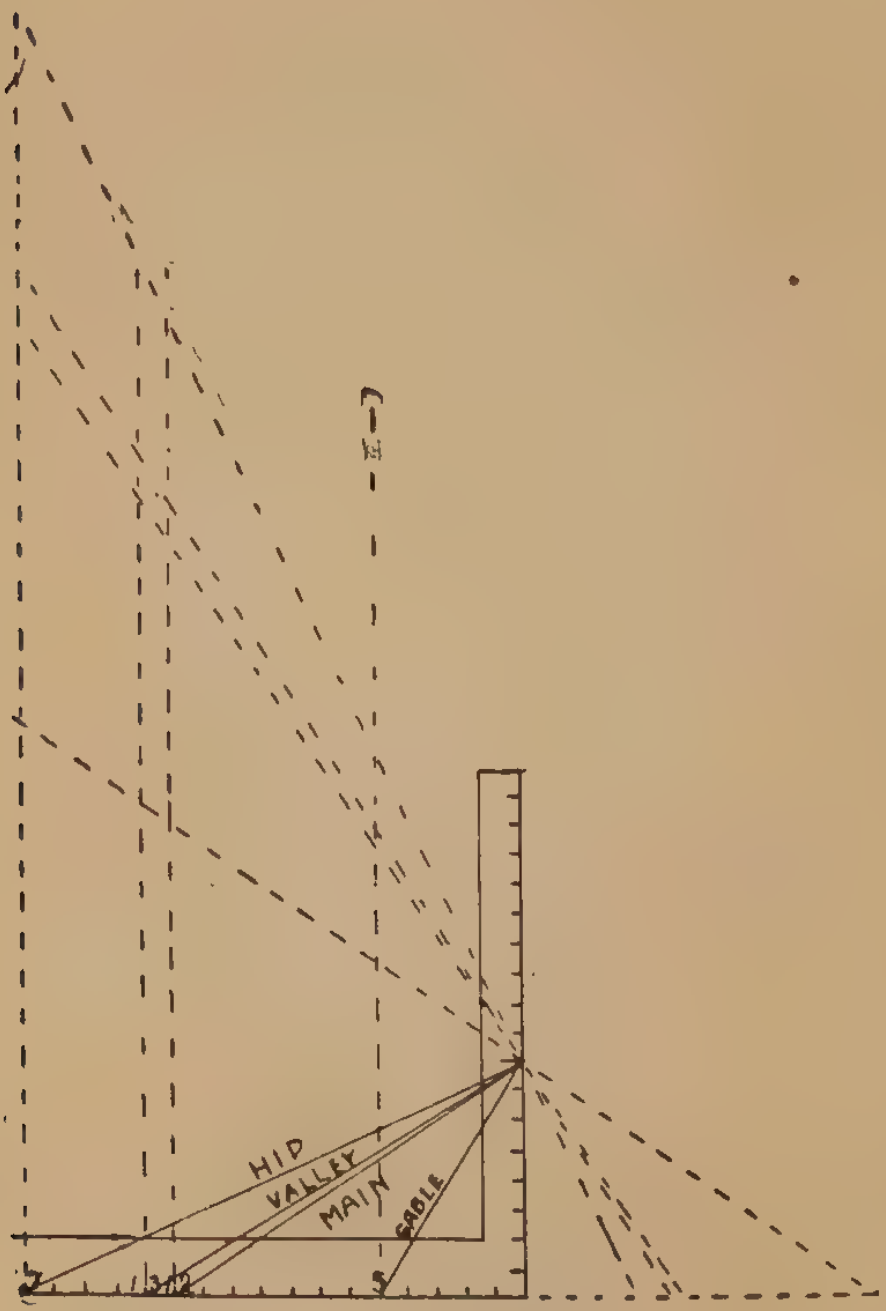


FIG. 34. PITCHES.

⅓ pitch house with ⅔ pitch gable actually looks.

Fig. 33. Construction of the roof, which could be made with or without ridge board. Refer back often to these illustrations and it will help you to understand the whys and wherefores.

Fig. 34. Shows the different pitches. The dotted lines at the right show the corresponding pitches, and are generally called co-pitch, while the dotted lines above are commonly called complement pitch.

While these corresponding pitches, their rises and runs, all have their bearings, it makes it too complicated for the average workman to figure it out entirely.

Fig. 35. To find the length of main rafter, as the roof is ⅓ pitch place the square on 8 and 12; as the roof is 20 feet wide, the run would be one-half the width, or 10 feet. Bring the 12 on square down to 10 (the run), and it gives 6 feet 8 inches, which is the

rise. Measure across the square from 10 to 6 8-12 inches and it gives 12 inches strong, or 12 inches and ¼ of 1-12, or 1-48 of an inch, which is a smaller measurement than it is often necessary to make. These inch measurements taken as feet would make the

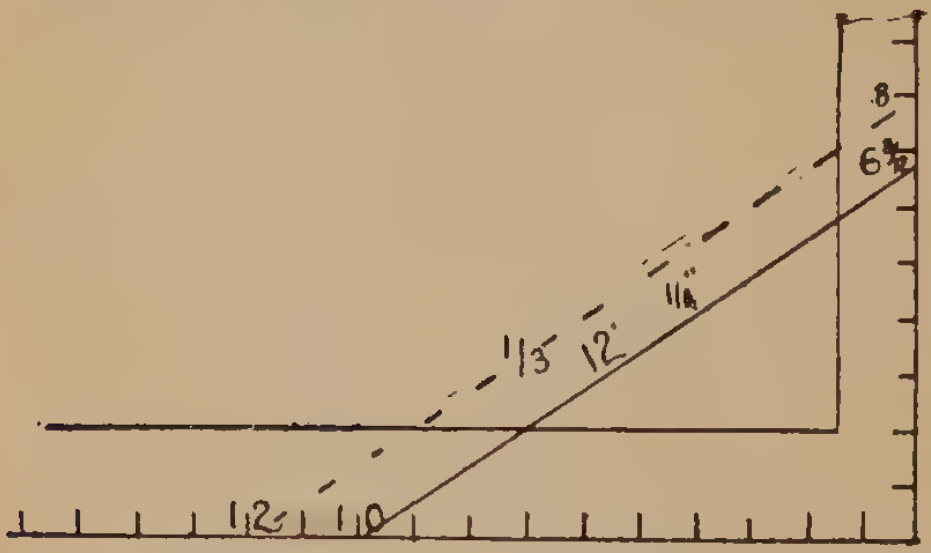


FIG. 35. LENGTH OF MAIN RAFTER.

rafter 12 feet and ¼ inch long. Or place the square on 8 and 12 ten times and it gives length and cuts.

Fig. 36. A ⅔ pitch roof with 6 feet 8-inch rise would have 5-foot run; measure across 5 inches and 6 8-12 inches and it gives 8 4-12 inches, or length of gable rafter 8 feet 4 inches.

Fig. 37. As the distance from plate to center of house is 10 feet and as the distance from center of gable to foot of

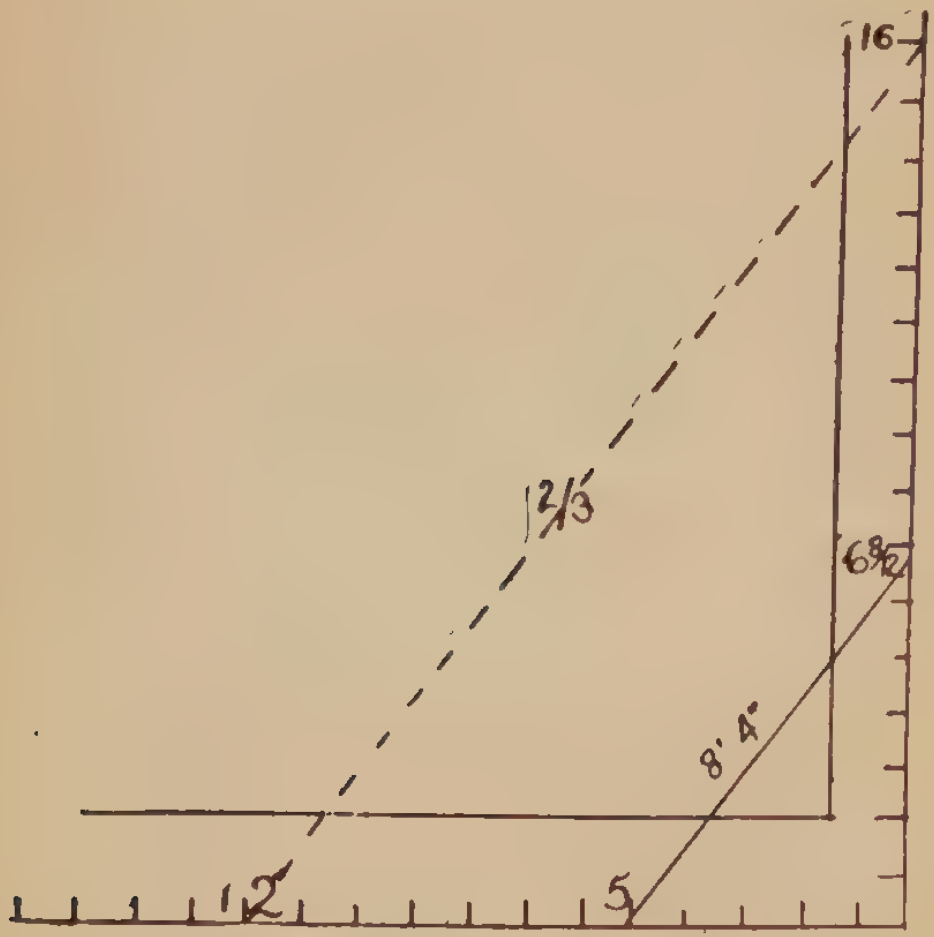


FIG. 36. LENGTH OF GABLE RAFTER.

same is 5 feet, therefore measure across square from 10 to 5 and it gives 11 and 2-12-inch strong (or ⅙ of 1-12 over). Length of run of valley, 11 feet 2 2-12 inches.

Fig. 38. Measure across the run of valley just found and the rise, and it

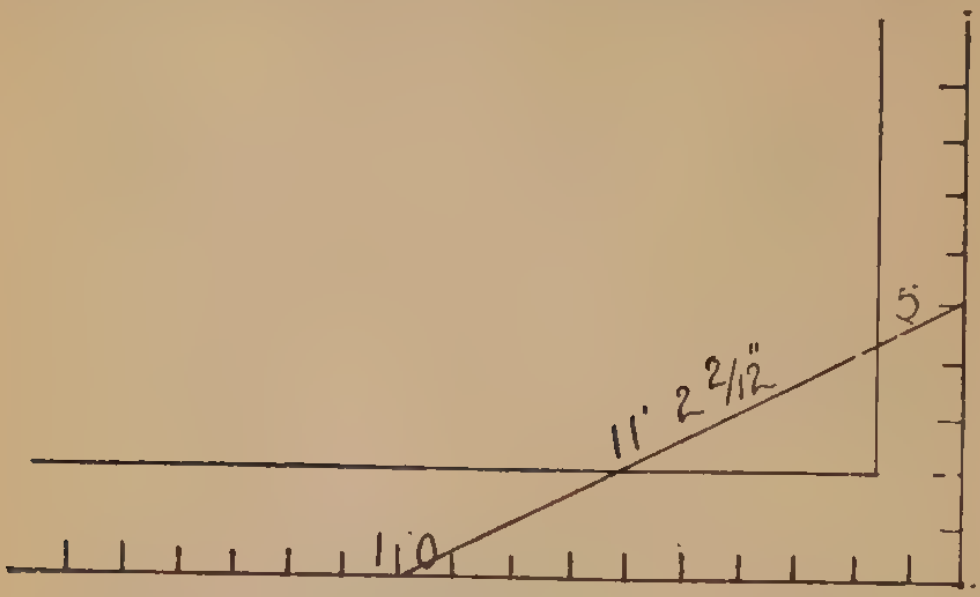


FIG. 37. RUN OF VALLEY RAFTER.

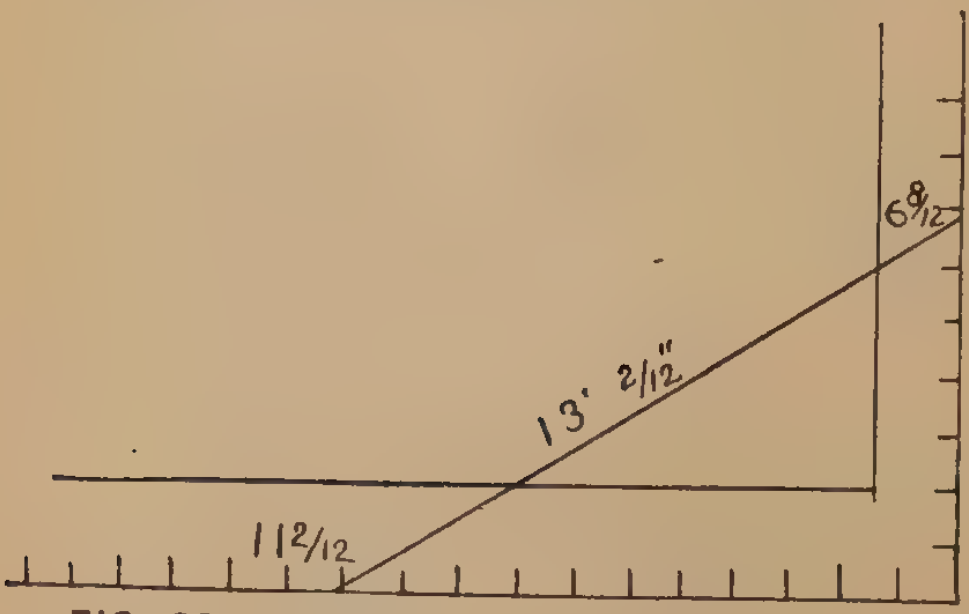


FIG. 38. LENGTH OF VALLEY RAFTER.

gives 13 feet 2-12 inches, length of valley rafter.

Fig. 39. The diagonal of 10 and 10 gives the run of hip and is 14 1-12 and ⅔ of another 1-12, or, as I often apply it, ⅓ of 1-12 less than 14 2-12 inches. These little fractional parts of 1-12 may seems a little complicated, and for ordinary work may not be at all necessary;

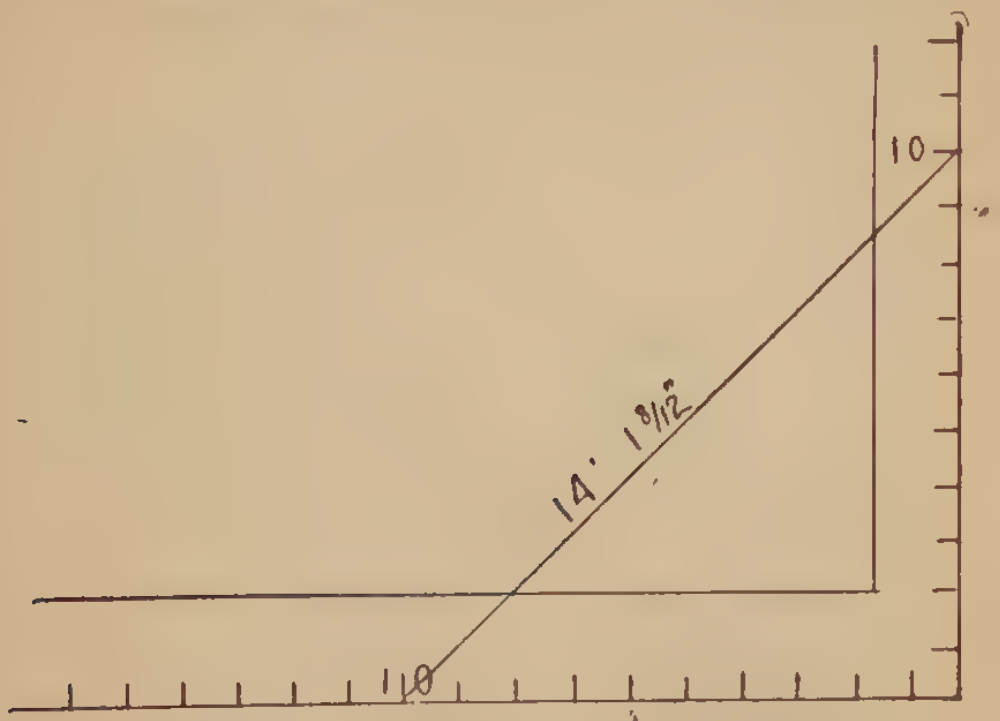


FIG. 39. RUN OF HIP RAFTER.

but I find it very easy to take accurate measurements and note just how strong the measurements are over the small 1-12 mark on the square, and cut my rafters accordingly and cut them to the fractional part of an inch.

For ordinary work a big pencil on a rough 2 by 4 will do, but real accurate measurements can be made on a jointed board with a pocket knife.

But the best way of all is to use one

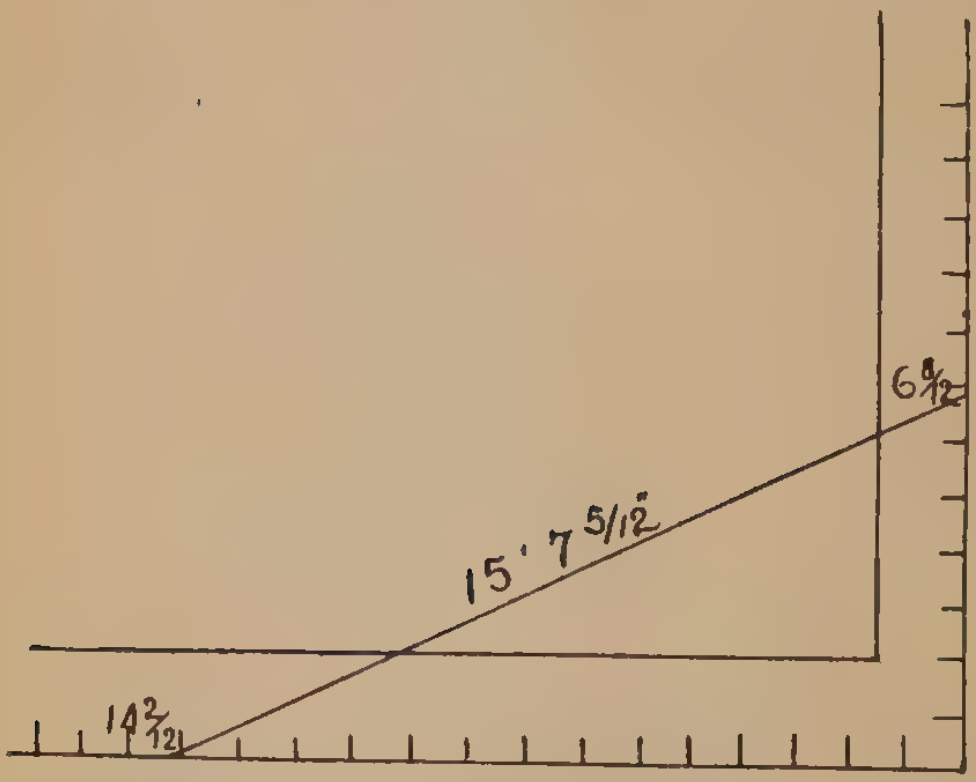


FIG. 40. LENGTH OF HIP RAFTER.

square to measure another square with. While I often get my measurements across the square with a cheap rule, I cannot recommend a cheap rule for accurate measurements.

Fig. 40. Take the run just found

and measure across to the rise, and it gives 15 feet 7 5-12 inches, length of hip rafter.

Fig. 41. As the hipped corner is 10 feet to place the jack rafters 2 feet apart there would be five 2-foot spaces or four jacks.

Lay a common rafter off into five equal parts, and use that for pattern for length of jacks for main roof.

For this roof there would be eight of each length, or four pairs—four cut with side bevel one way and four with side bevel the other way. That gives all the jacks for main roof except the jacks against the front valley. Note there are only three common rafters cut square across at top, and they are in center of back side of house, while the other two against top of hip are same length on the long side, but they are cut off at top with side bevel, same as jacks to fit hip.

The two at end can be laid off full length, and then measure square back

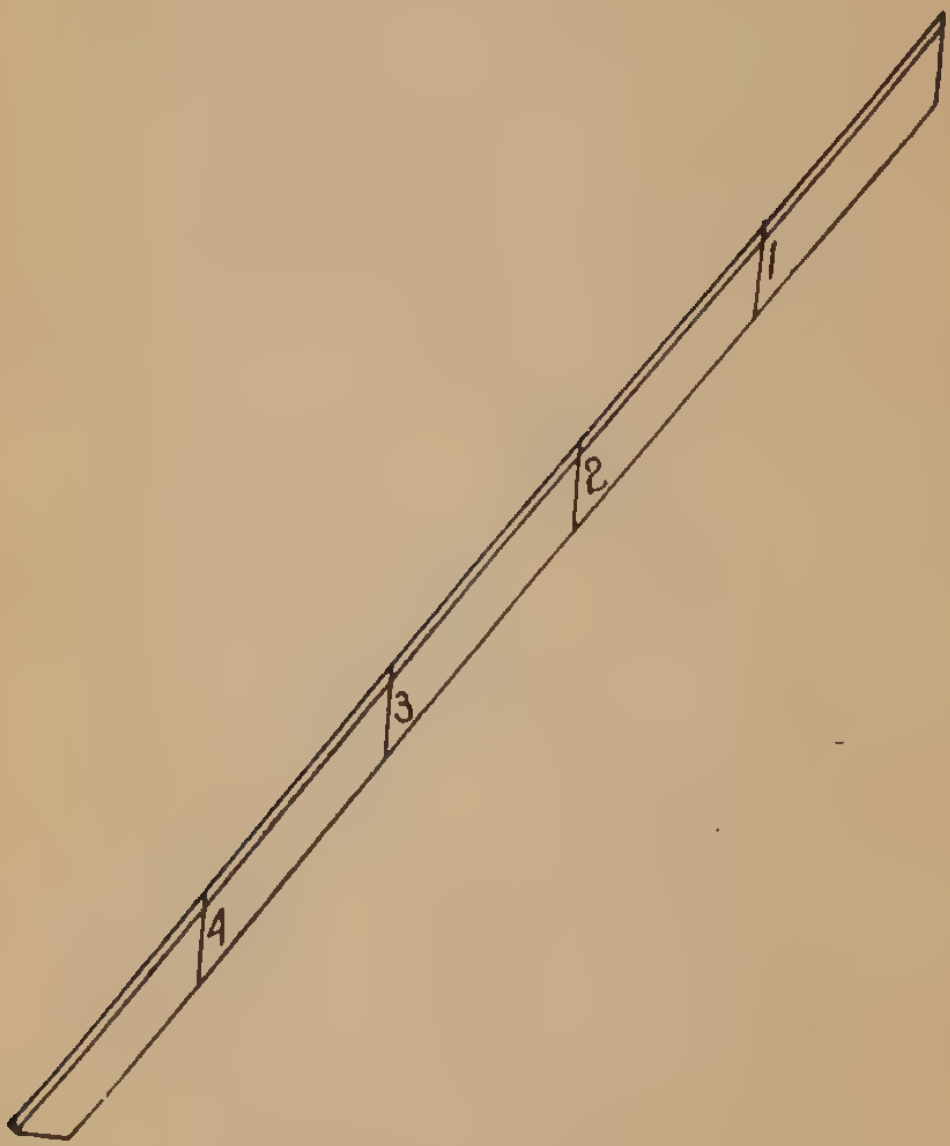


FIG. 41. LENGTH OF JACK RAFTERS.

(not down the rafter) 1 5-12 inches, and cut with bevels both ways.

Some good framers prefer to cut the main rafter square and put them up first and the one in center at end should be cut just 1 inch (square back) shorter: then put in the hips. This method causes more trouble than the way I illustrated simply because everything must be absolutely perfect or a big heavy hip is liable to be raised and then taken down and recut even if it is only a fractional part of an inch too long.

Again if it is too short, as I have no doubt many of the readers have often seen, the remedy is to put in a shingle, piece of board, or often even a 2x4 at top to make it long enough.

The way I illustrated there might be a miss of a full inch or more and yet have perfect joints and practically a perfect roof and no lost time patching it up.

Some might say a mechanic should

get everything absolutely accurate: but we must remember that as long as we have not yet seen a perfect person we

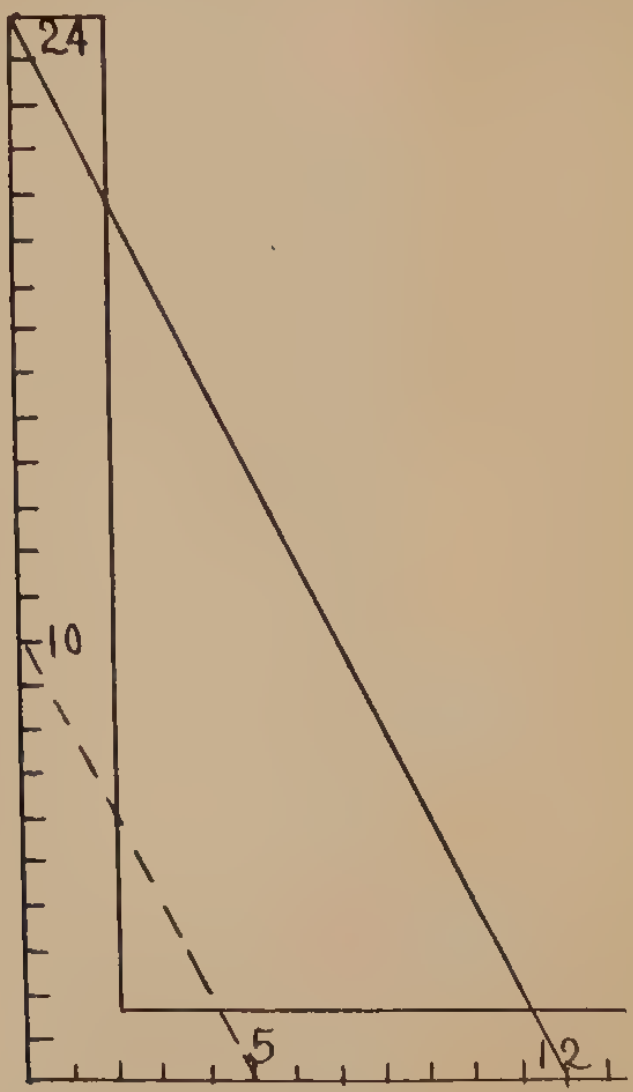


FIG. 42. MEASUREMENTS FOR JACK RAFTERS

cannot expect perfection and must all through life plan to meet the small defects that the human being is liable to.

Lay off front rafters against top of hip, same as back ones, as their bottoms strike over one foot on valley rafter.

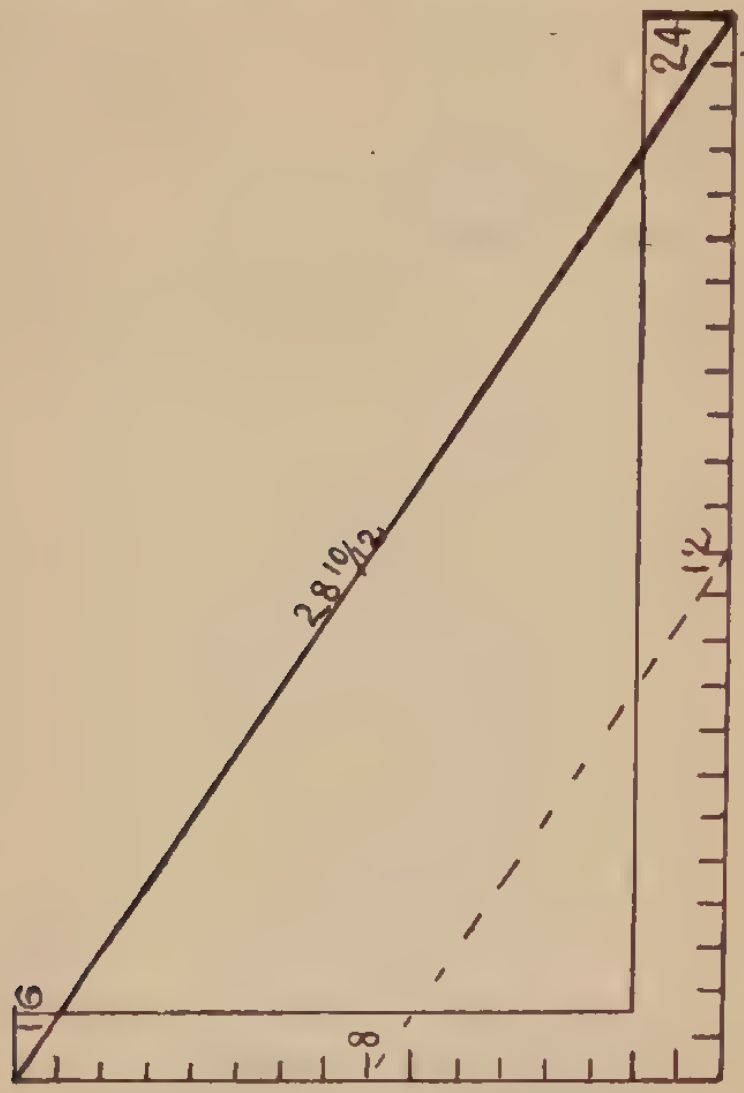


FIG. 43. LENGTH OF JACK RAFTERS AGAINST GABLE.

Fig. 42. One foot over makes 2-foot run, or it makes that rafter run 2 feet less than common rafter.

Fig. 43. To get the length that it is shorter than common rafter, measure across the square from 24 inches to 16 inches (which is ⅓ pitch), and it gives

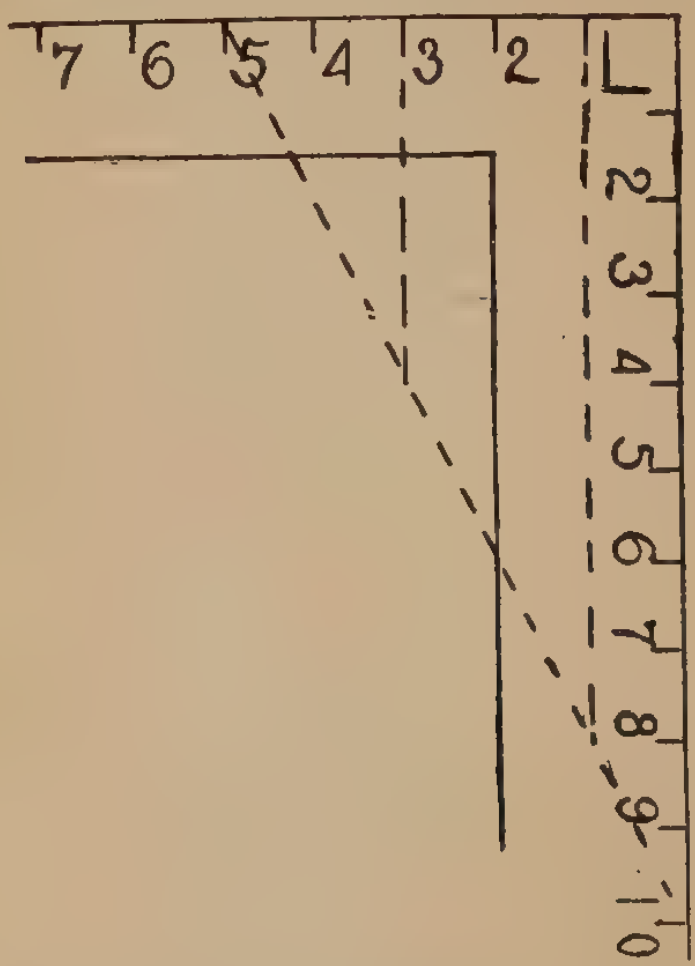


FIG. 44. RUN OF JACK RAFTERS.

28 10-12 inches. This rafter should be that much shorter than common rafter. As there is only 4 feet from this to center of gable, it will only take one

rafter in center; therefore the other rafter should be just ½ this length.

Fig. 44. Take square and measure across from 5 to 10 the position of valley rafter, and measure down from 3 and 1 to the valley line and it gives the run of jack; measure across the square the run and rise and it gives length of jacks.

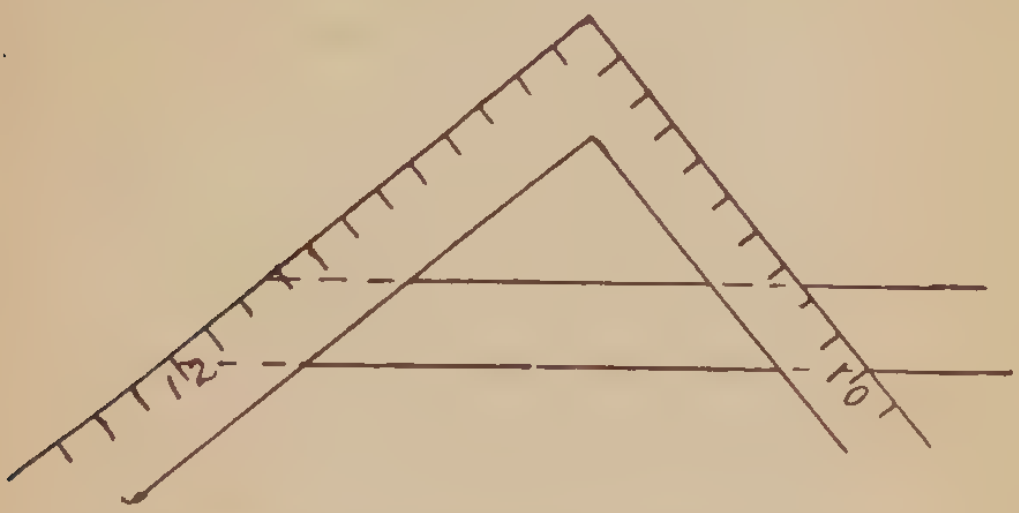


FIG. 45. SIDE CUT OF JACK RAFTER AGAINST HIP RAFTER.

Fig. 45. The side cut of jacks to fit against hip is length and run cut on length.

As it is not easy to keep track of the entire length and run of each jack, we

simply take the length and run of common rafter, as illustrated, or 1-foot length and run is a very handy way.

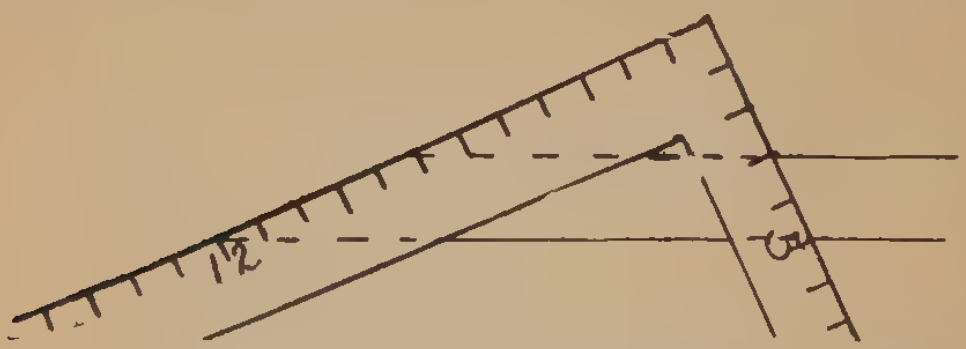


FIG. 46. MAIN JACK RAFTER AGAINST VALLEY RAFTER.

One foot of run on a ⅓ pitch roof 14.42 is length of rafter, which is practically 14 5-12 inches, though for the

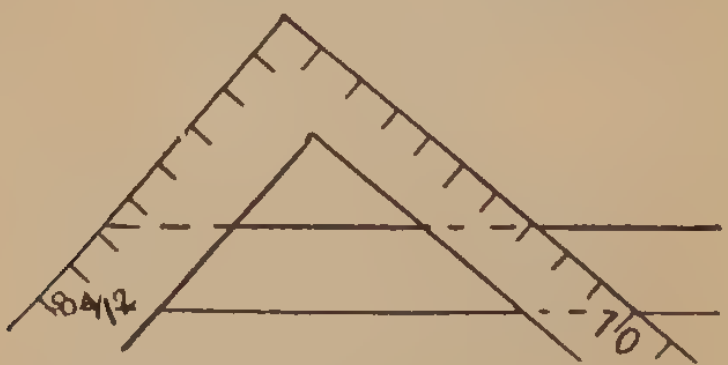


FIG. 47. GABLE JACK RAFTER.

bevel of jack 14½ inches is near enough. I generally use it 12 and 14½ inches (just a little scant); cut on the latter.

Fig. 46. The side cut (or bevel) of main jack to fit valley is length of main rafter and run of gable; cut on length.

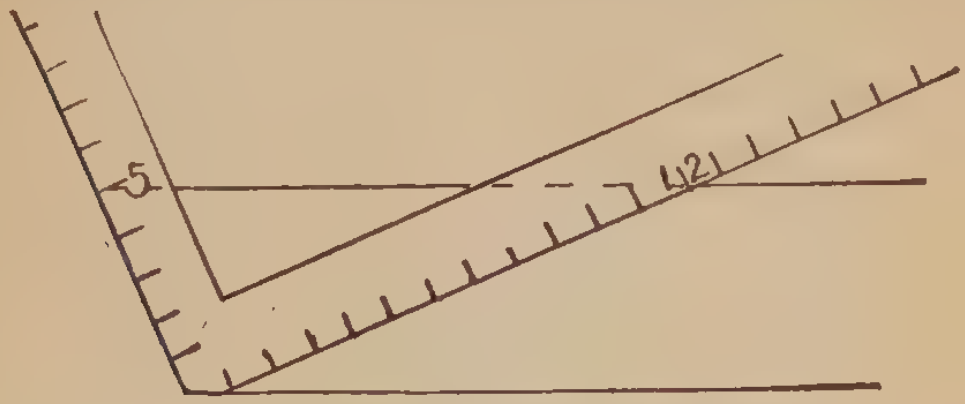


FIG. 48. BOARD FOR VALLEY.

Fig. 47. The side cut of gable jack to fit valley is length of gable rafter and run of main roof; cut on length.

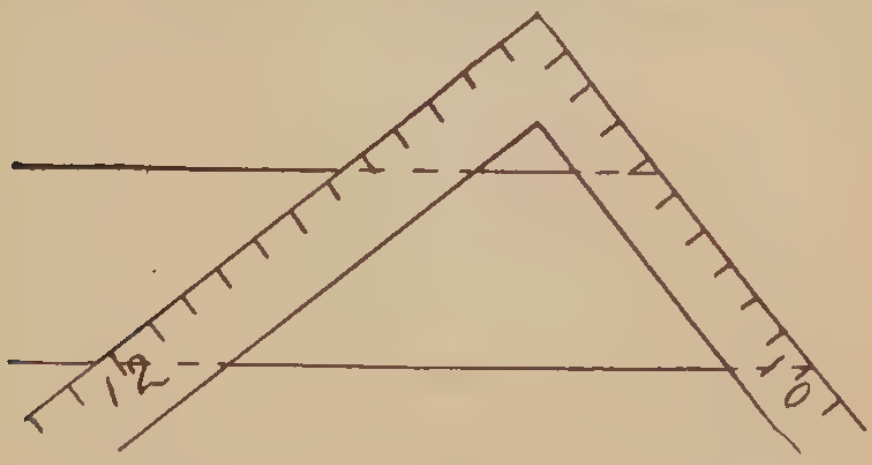


FIG. 49. BOARD FOR HIP.

Fig. 48. The boards in the valley are length of common rafter and run of gable; cut on run.

Fig. 49. The boards at hip are length of common (or main) rafter and run of main roof; cut on run.

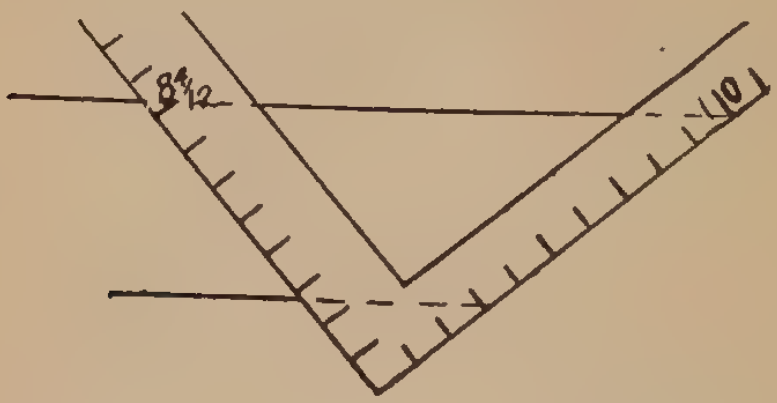


FIG. 50. BOARD FOR GABLE VALLEY.

Fig. 50. The boards in valley on gable are length of gable rafter and run of main; cut on run.

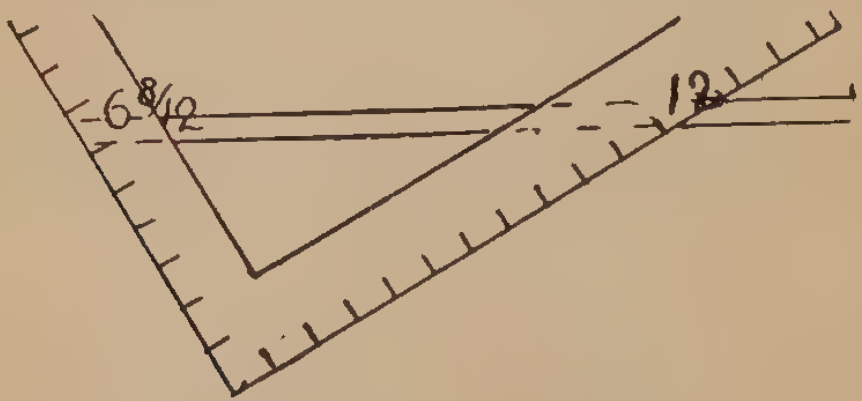


FIG. 51. SIDE CUT AT VALLEY.

Fig. 51. The side cut of board at valley is length of main rafter and rise of gable; cut on rise.

Fig. 52. The side cut at hip is length of common rafter and rise of main roof; cut on rise.

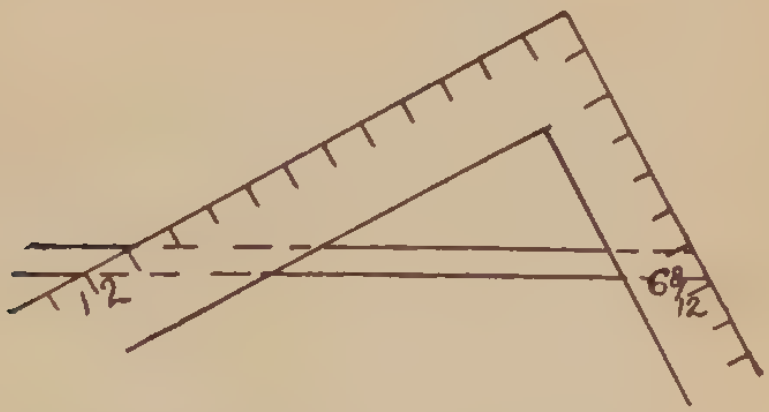


FIG. 52. SIDE CUT AT HIP.

Fig. 53. The side cut of board on gable to fit valley is length of gable rafter and rise of main; cut on rise.

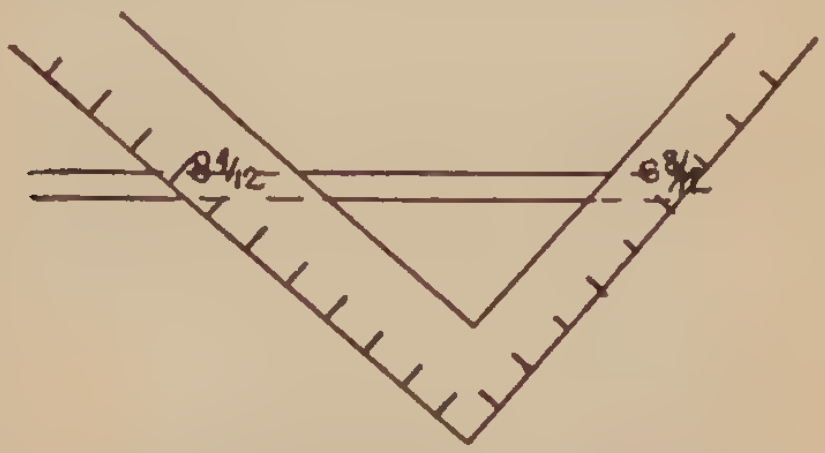


FIG. 53. GABLE CUT AT VALLEY

Fig. 54. To cut a gutter board that stands out square with the roof and

butts against the gable, use these same figures. If the board was beveled to fit

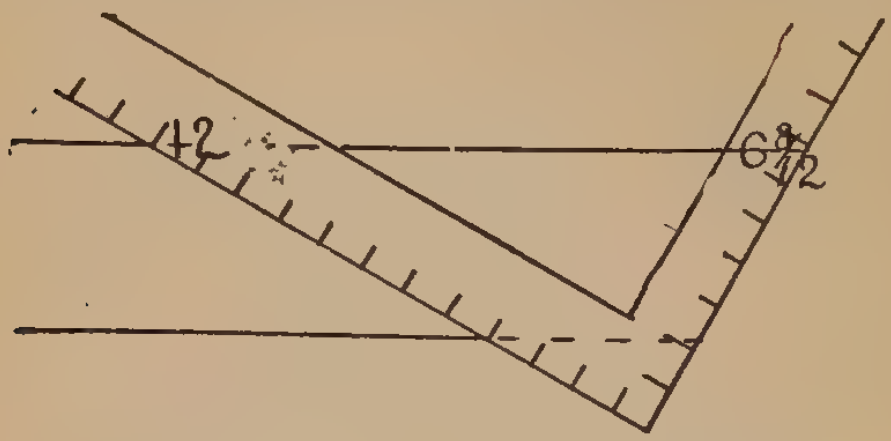


FIG. 54. VALLEY CUT OF GUTTER.

the roof and stand plumb, it would simply be cut the pitch of gable.

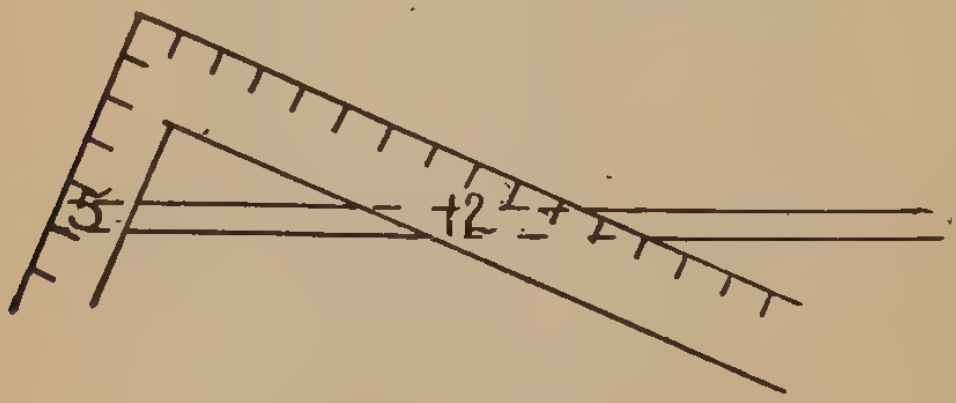


FIG. 55. SIDE CUT OF GUTTER.

Fig. 55. The side cut is the same figures as the main jack cut against the valley, only it is cut on the other figure. (See Fig. 46.)

Fig. 56. The gutter cut at hip is length of main rafter and rise; cut on rise.

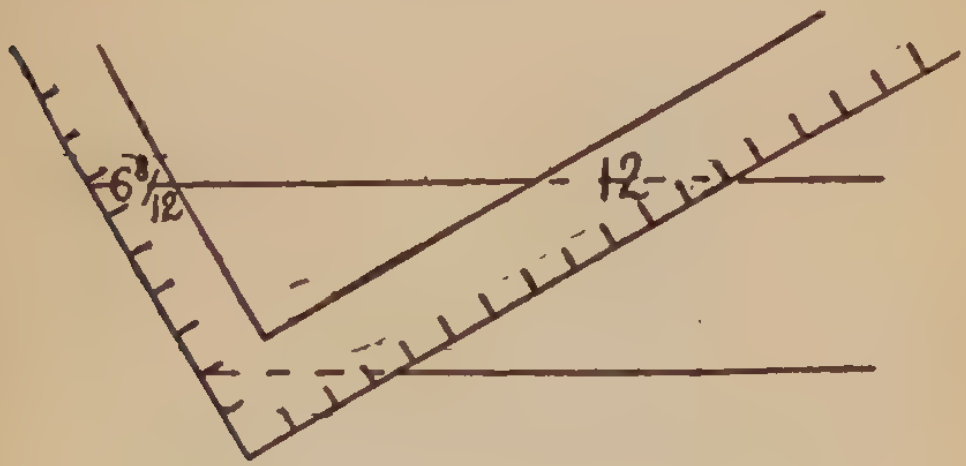


FIG. 56. GUTTER CUT AT HIP.

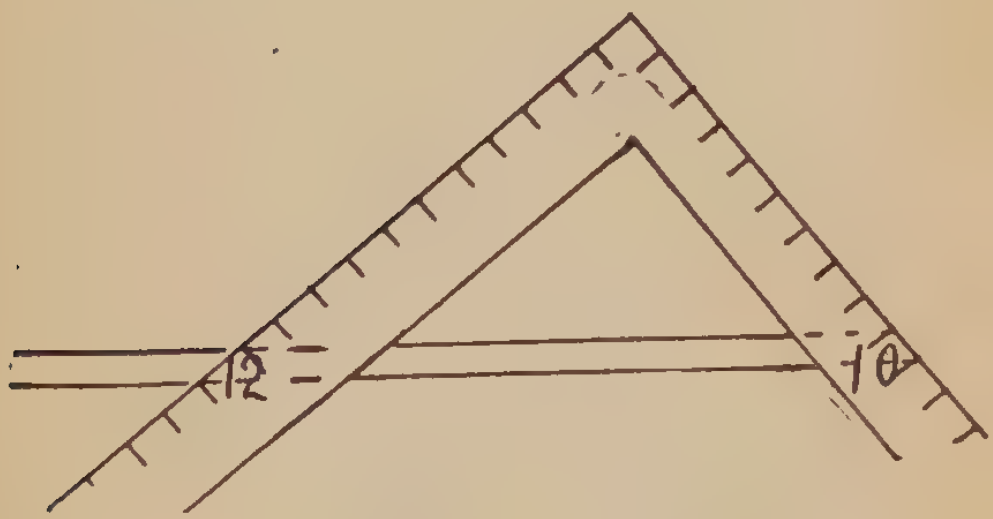


FIG. 57. SIDE CUT OF GUTTER.

Fig. 57. The side cut of gutter at hip is length of rafter and run; cut on run. The top piece on gutter and

mouldings are cut on these same cuts, only, of course, the main cut of the cap (or top piece) is same as side cut of gutter board, while the side cut of cap is main cut of gutter board, etc.

It seems to me that this covers the subject of roof framing quite completely and the many words I have received about successful jobs of roof framing by the aid of this book is further evidence of the fact that it does fairly well. Still some write: "I had fine luck by framing from your book and understand about the common and hip rafters, yet I do not fully understand the jacks, especially the side cuts."

It seems hard to understand that the principle here explained can be applied on any roof, therefore I have decided to make these points plainer if possible by giving more illustrations along the same line, showing that these applications apply to all roofs.

Side cuts are simply "Length and

Run, Cut on Length; 5-12 for Octagon; Run on Opposite Side for Uneven Pitches;" which I believe practically covers it.

Now possibly some one will say that isn't it at all; the run has nothing whatever to do with the side cuts; it is the tangent and not the run that deals with side cuts, which I will admit is all very true. But nevertheless even if it is, I prefer to still use the run simply for this reason, there is just one less thing to deal with, and we carpenters have too much to think of to get everything into our heads.

Fig. 58. Study this carefully and you will notice that the run and tangent are the same on all ordinary roofs where the pitches are the same and the hips and valleys are at an angle of 45 degrees, as they are on possibly 99 per cent. of the buildings.

While 5-12 the run is the tangent of the octagon, should the cut be as the hip and octagon come together? Of

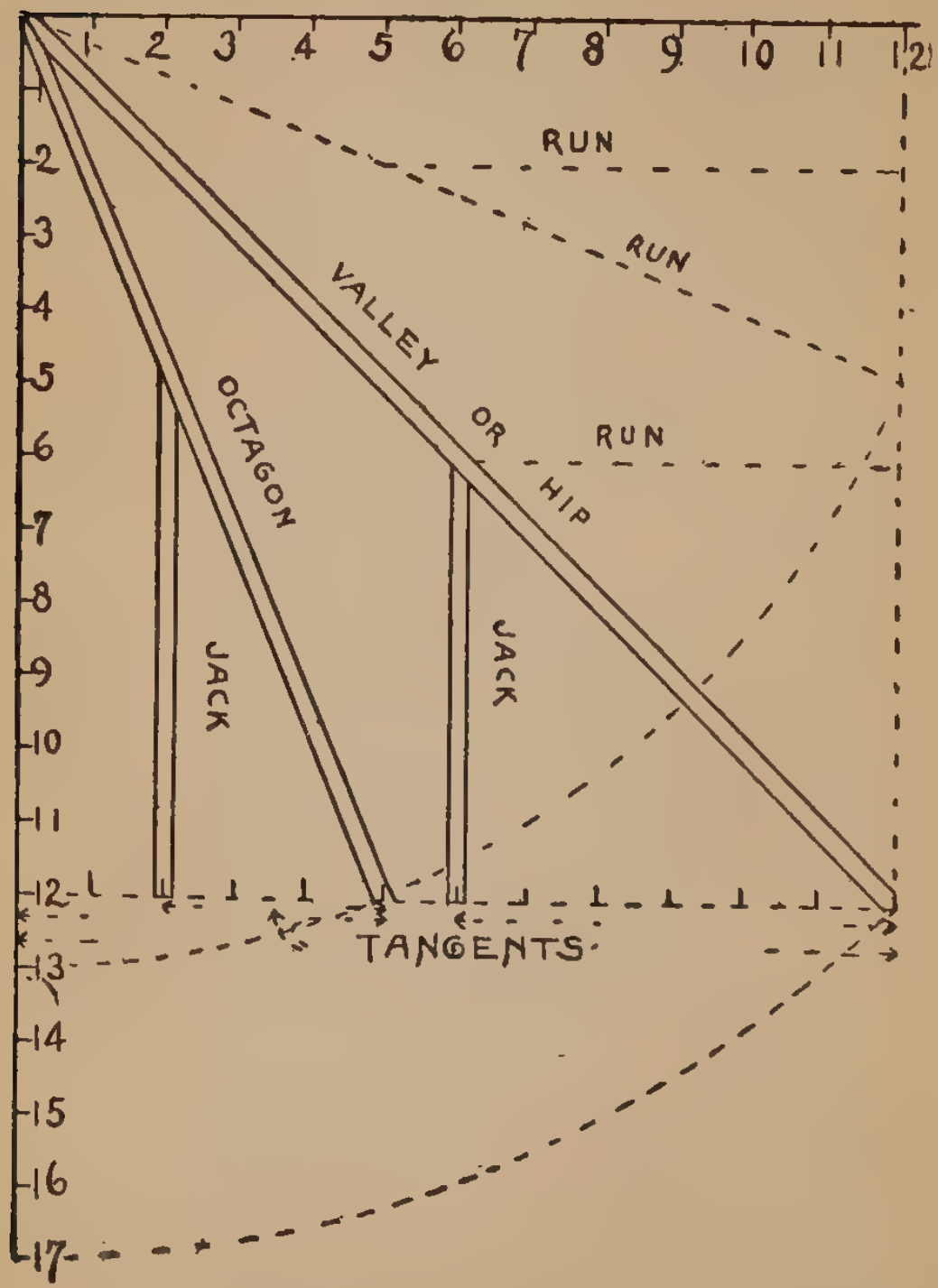


FIG. 58. TANGENT, RUNS AND RAFTERS.

course, as you will notice, the hip and octagon cut there meet each other half way. Also note how and why it is that 5-12 of run is tangent of octagon and why a foot of common run is thirteen inches octagon, and practically seventeen for hip.

While the diagonal of 5 and 12 is exactly 13, yet 5-12 is not an exact octagon, though it is almost exact and near enough for all practical purposes.

It might be well to make a good study of this and figure all these different rises, runs, pitches, tangents, cuts, etc., and understand the whys and wherefores. And if you care to take up the subject further notice the little drawing, Fig. 34, which shows pitch, co-pitch and complement pitch. If you wish take them up and take their rises and runs you will find you can travel on and on, there is practically no end to it, and that's one reason why I say, make rise, run and length answer your whole purpose and not get tangled up with too many tangents, complements, etc.

Fig. 59. Shows the method of laying off side cut of hip or valley, which is simply, take the run and length of hip or valley and cut on length. Now all these cuts can be taken the real length, using inches instead of feet on

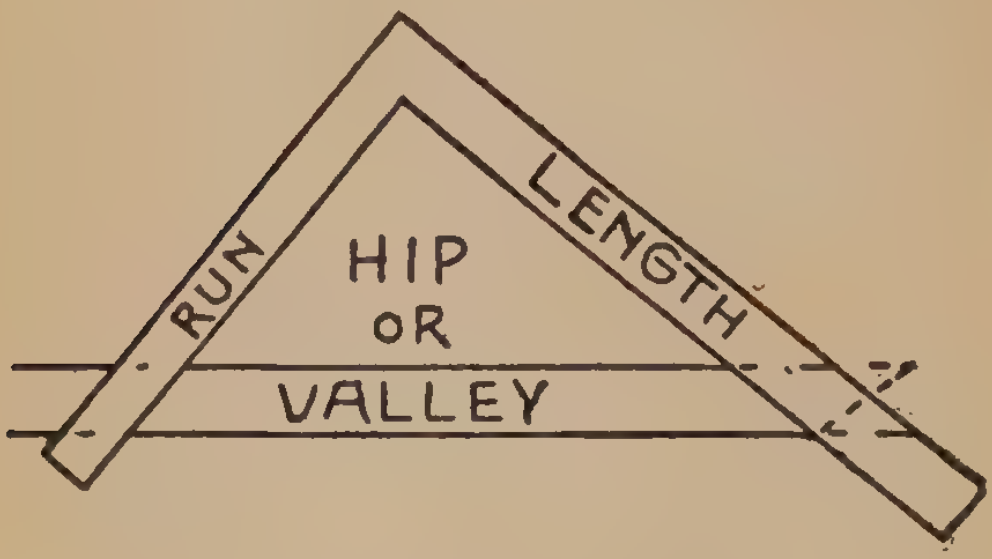


FIG. 59. SIDE CUTS OF RAFTERS.

the square. Or it can be taken full size on the square and simply take one foot of run and length.

Fig. 60. Is side cut of jack, which is the same, only of course it is run and length of jack, cut on length.

Fig. 61. Is octagon. Of course

there are so many different ways octagon rafters may meet at the top that

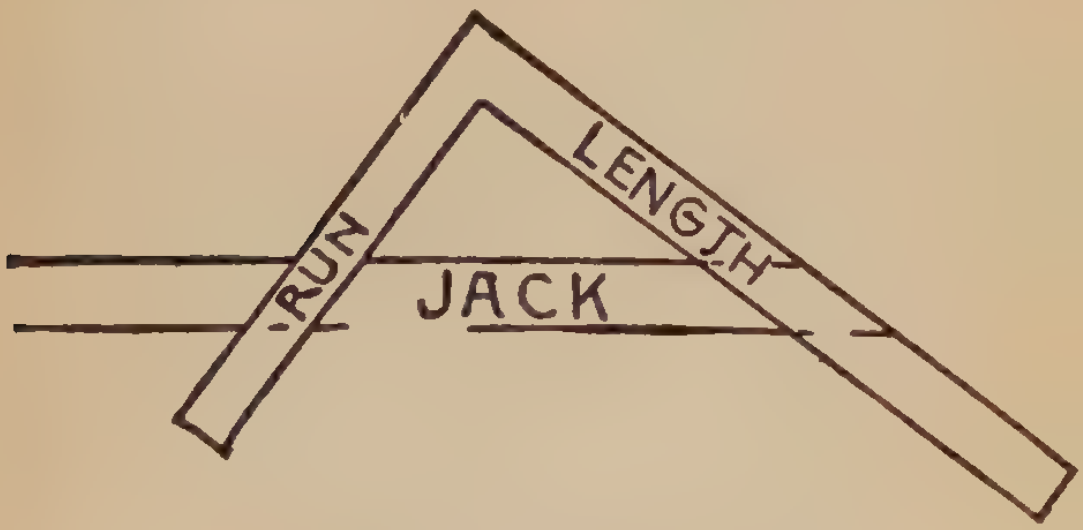


FIG. 60. SIDE CUT OF JACK.

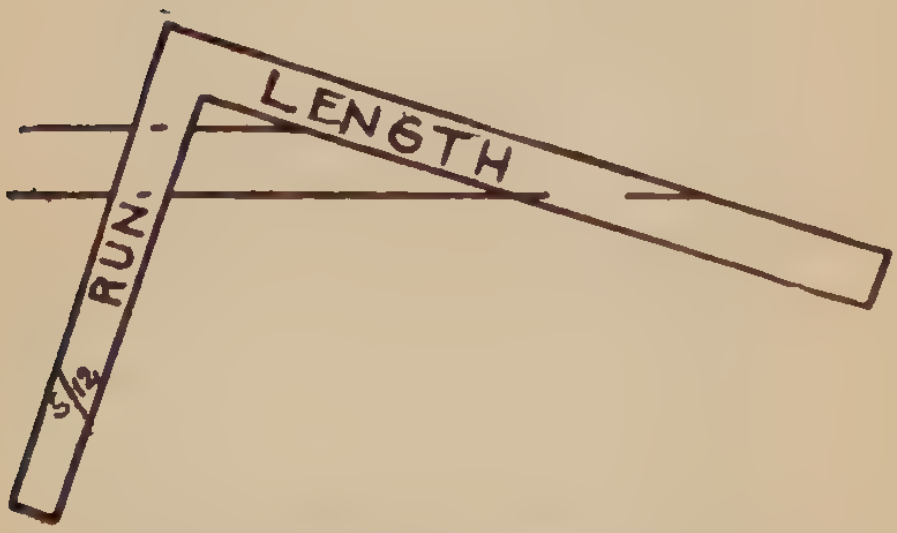


FIG. 61. SIDE CUT OF OCTAGON.

how it is constructed at top has to be considered before the cut can be made.

5-12 of run and length, cut on length would make a cut to fit against ridge or side of hip rafter, though if they

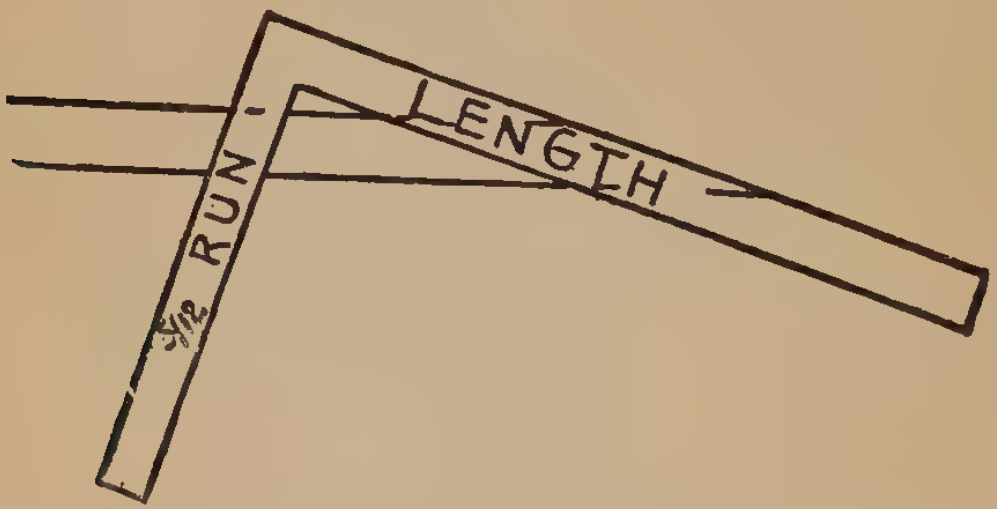


FIG. 62. SIDE CUT OF OCTAGON JACK.

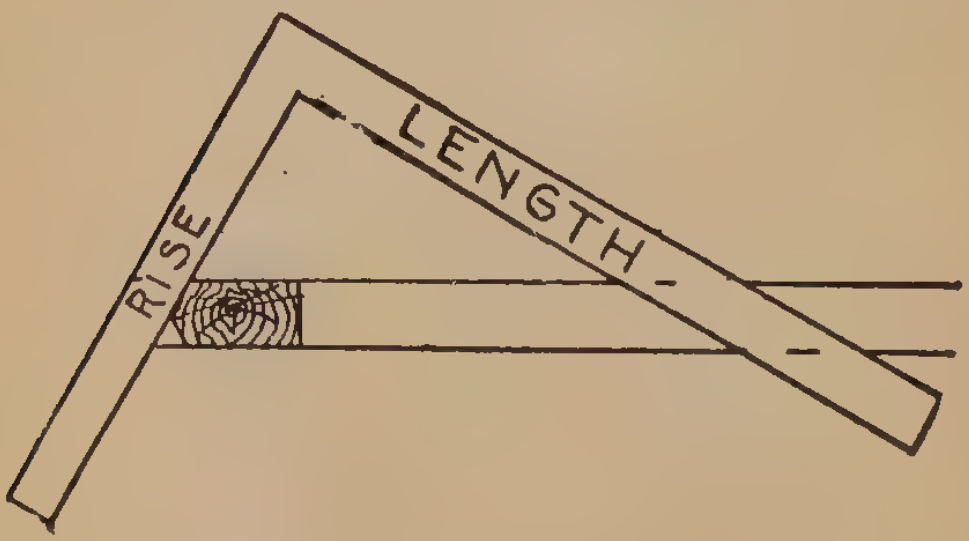


FIG. 63. BACKING OF HIP.

both were cut together it would be one-half that, etc., etc.

Fig. 62. Octagon jack, is 5-12 of

rum and length, cut on length, side cut of jack to fit against octagon hip.

Fig. 63. To back hip take rise and length, cut on rise. The old rule used to be one-half that for octagon, which I guess is near enough for all practical purposes, for it is indeed very seldom done in ordinary work.

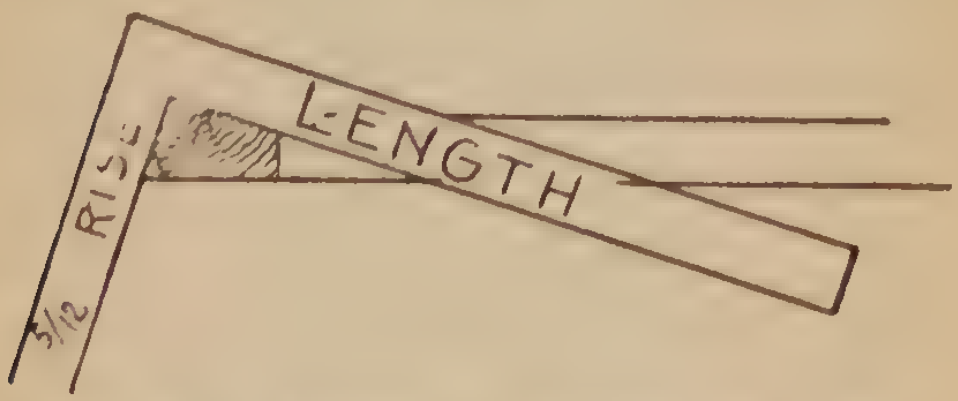


FIG. 64. BACKING OF OCTAGON HIP

Fig. 64. Gives the backing of octagon hip, which I expect is just about one shaving nearer than the old rule. Of course the cutting out of valley would be the same method, though as I mentioned before, this is something seldom done and is not at all necessary in ordinary work.

Uneven pitch roofs are something

that should be avoided as much as possible, as ordinarily the roof or the cornice of an uneven pitch building does not present as nice an appearance as a uniform one of all same pitch. Yet there are instances that an uneven pitch roof adds to the appearance, and there are many other times that they are unavoidable and have to be so constructed even if they should mar the appearance. And while they are not so very common, yet they are common enough that every builder should be familiar with the principles of their construction.

Fig. 65. At the top I have illustrated an elevation of a ⅔ pitch gable on a ⅓ pitch roof. While below the main drawing illustrates the plan of construction of the above uneven pitch roof. Note the width of gable is ten feet, while from plate to ridge is also ten feet. The run of gable, of course, is half the width, or five feet, while the run of main roof is ten feet.

Now remember as this is a plan all these measurements are level measure-

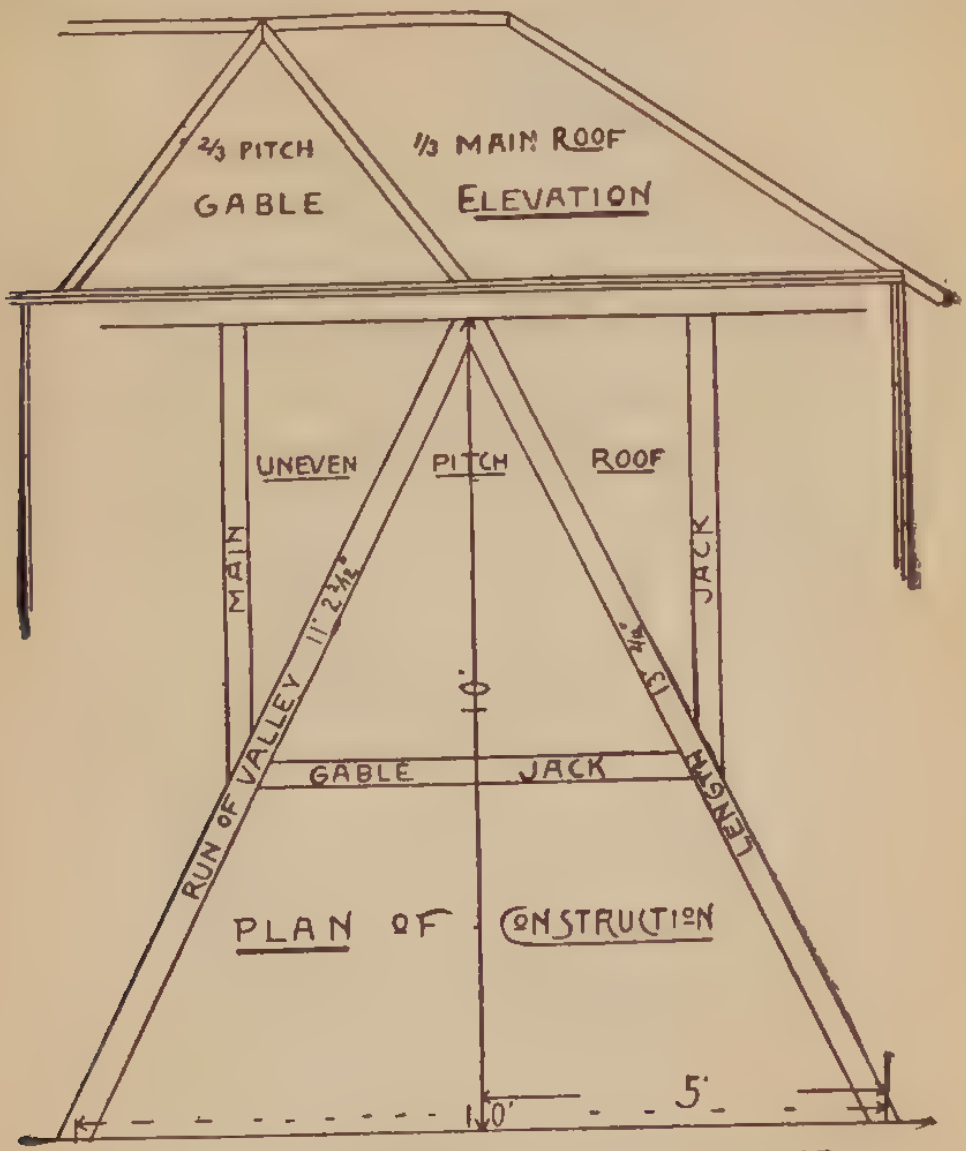


FIG. 65. ELEVATION, PLAN AND CONSTRUCTION.

ments or are the runs (not the rise), the pitch of the roof gives the rise which in this roof is 6 feet and 8 inches

I thought best to give these few measurements here, as the reader might be better able to fully understand what I wish to illustrate.

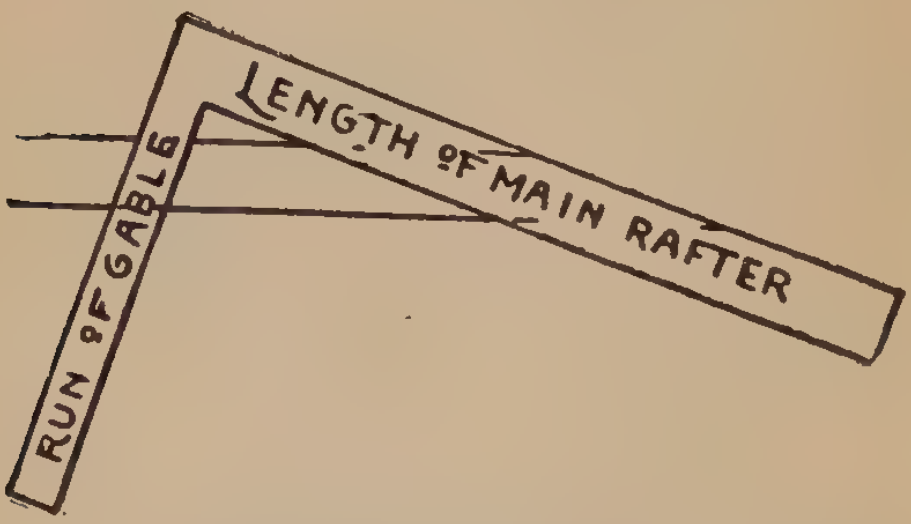


FIG. 66. SIDE CUT OF JACK FOR UNEVEN PITCHES.

Fig. 66. Illustrates the side cut of main jack to fit against valley, which is run of gable and length of main jack, cut on length.

Fig. 67. Gable jack to fit against valley, run of main, length of gable rafter cut on length. The side cuts at the top of valley rafters; any carpenter knows if they laid down level as the joist do it would simply be cut on five

and ten and vice versa, ten and five. But as they raise up to form the pitch of roof they are cut back according to the pitch and the point of the rafter becomes more pointed just the same as all these cuts we have just mentioned. The majority of the carpenters prob-

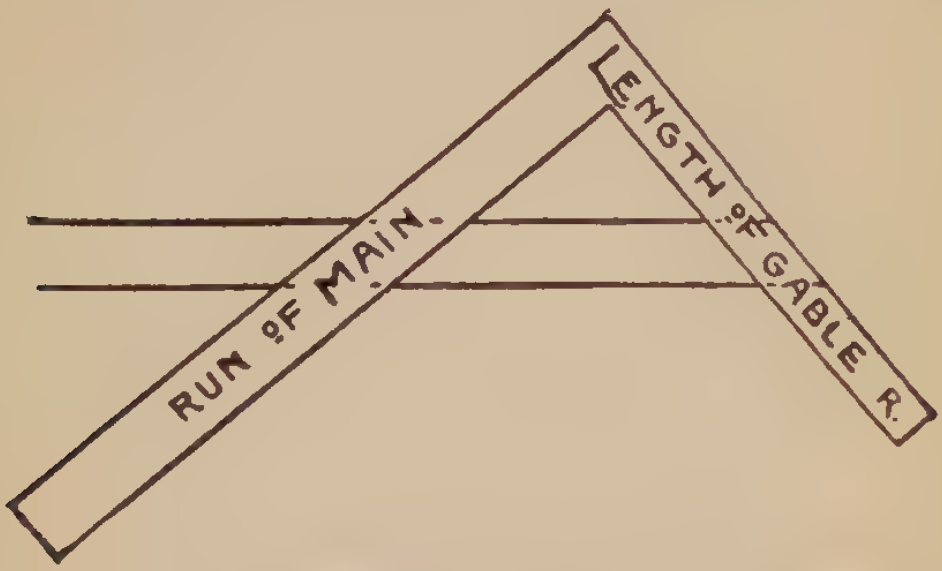


FIG. 67. OPPOSITE JACK ON UNEVEN PITCH ROOF.

ably would know near enough the amount to cut stronger than the five and ten cut and would cut it back and get it near enough for ordinary work. Just as a foreman told me not long ago that he knew that if the rafter lay level the cut of an ordinary jack would be

cut on twelve and twelve, or what we commonly call square miter, and he knew that when a roof raised up to half pitch, seventeen and twelve cut it. If it were over half-pitch it would be more than seventeen and if less 'twould be less, and in laying off probably thousands of roofs and perhaps a million jacks in his life he had been satisfied with his guess, and he had become an expert gutterer, and a good roof framing guesser.

I mention this as it is not only a fact but quite a common fact at that, and I wish to say further before I get back to my subject that I am getting away from, that likely every reader of this book may be perfectly familiar with all these simple and common side cuts, yet it is surprising how many carpenters there are yet in our land that know practically very little about them.

As this gable run is five feet and main run ten feet this is of course very simple, as the gable would be just one-

half the run, which is the tangent of gable, while the main is twice the run, etc.

Even if it wasn't just one-half, the figuring could probably be figured practically as easy; but I give here another way I have found very convenient.

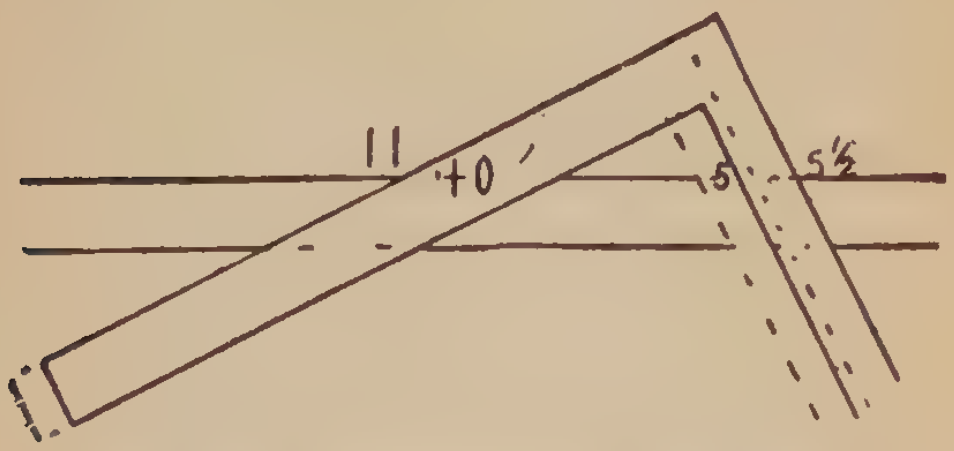


FIG. 68. MEASUREMENT FOR CUT.

While I have given the actual run on the drawing as it is, 11 feet 2 2-12 inches, and the rafter 13 feet and 2-12 of an inch, yet for convenience in illustrating we will call the run an even 11 feet and rafter 13 feet.

Fig. 68. As the run of gable is five and the run of main ten, place the

square on five and ten and as the run of the valley is eleven, move the square up to eleven and we find we have five and a half, which is the run we wish.

Fig. 69. Place the square on 5 and a half, the run just found, and on thirteen, length of rafter; cut on length and it gives side cut of valley rafter in

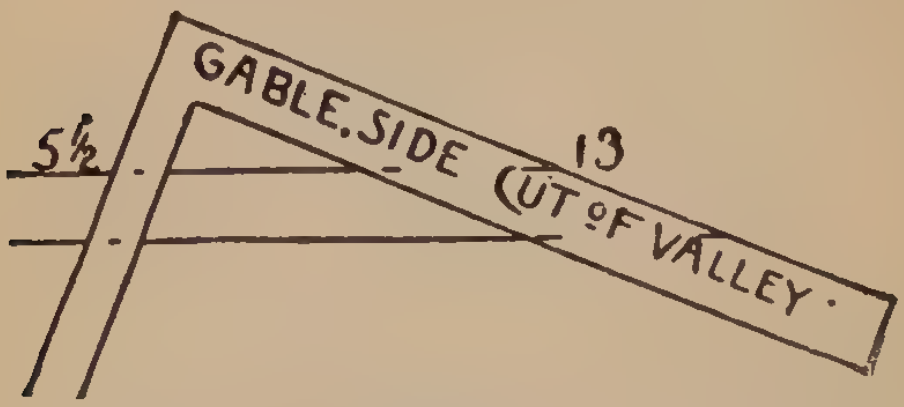


FIG. 69. TOP SIDE CUT OF UNEVEN VALLEY.

gable; look back to Fig. 65 and note this is the cut in center of drawing at top of valley rafters, while the top cut to cut against ridge is found as illustrated.

Fig. 70. Place the square again on the five and ten, move up to eleven and it gives our run twenty-two, and then

take that and apply it, Fig. 71 illustrates it, twenty-two the run just found,

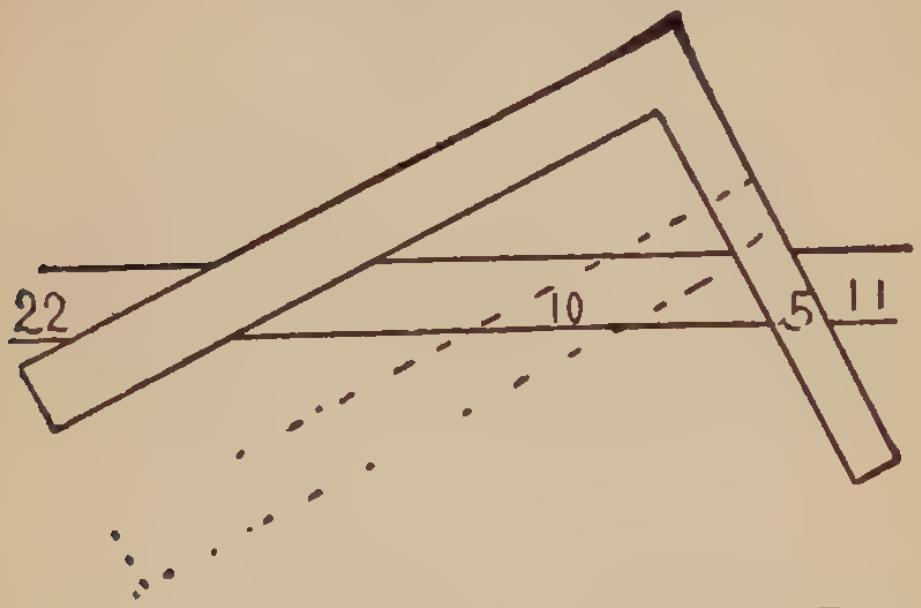


FIG. 70. ANOTHER MEASUREMENT.

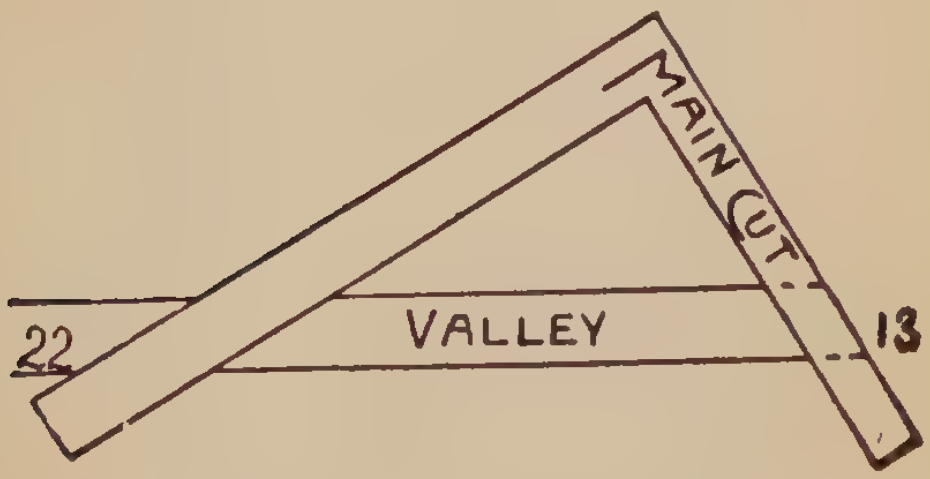


FIG. 71. TOP SIDE CUT.

and thirteen length of rafter, cut on length and it gives top cut to fit ridge.

Fig. 72. A miter box to cut these mouldings should be cut on these same cuts, one bevel across the top and the other down the side of the box.

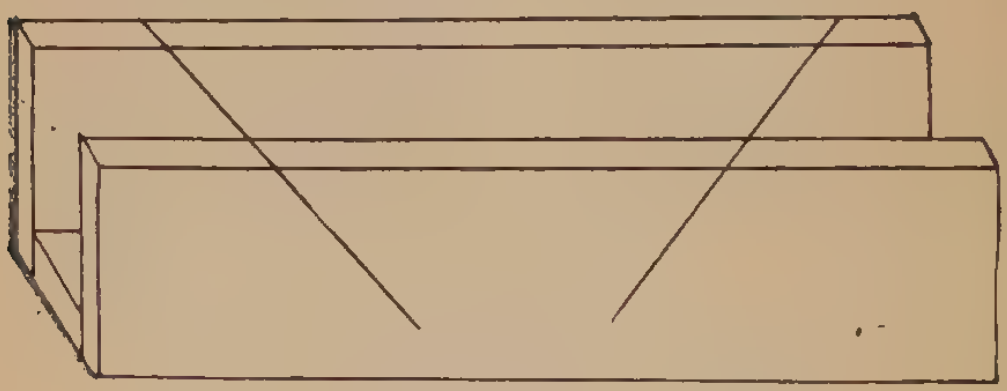


FIG. 72. MITERING MOULDINGS.

Fig. 73. To cut the facia and frieze boards to intersect at valley, take length (8 4-12 inches) and run (5 inches) added together (13 4-12 inches), and rise (6 8-12 inches); cut on rise.

Fig. 74. Hoppers are nothing but hip roofs turned the other side up, or, again, the gutter board at hip is a perfect hopper cut, though the cut for the hopper is taken from the flare of hopper, instead of pitch of roof, which is a co-pitch to the roof. If the hopper was

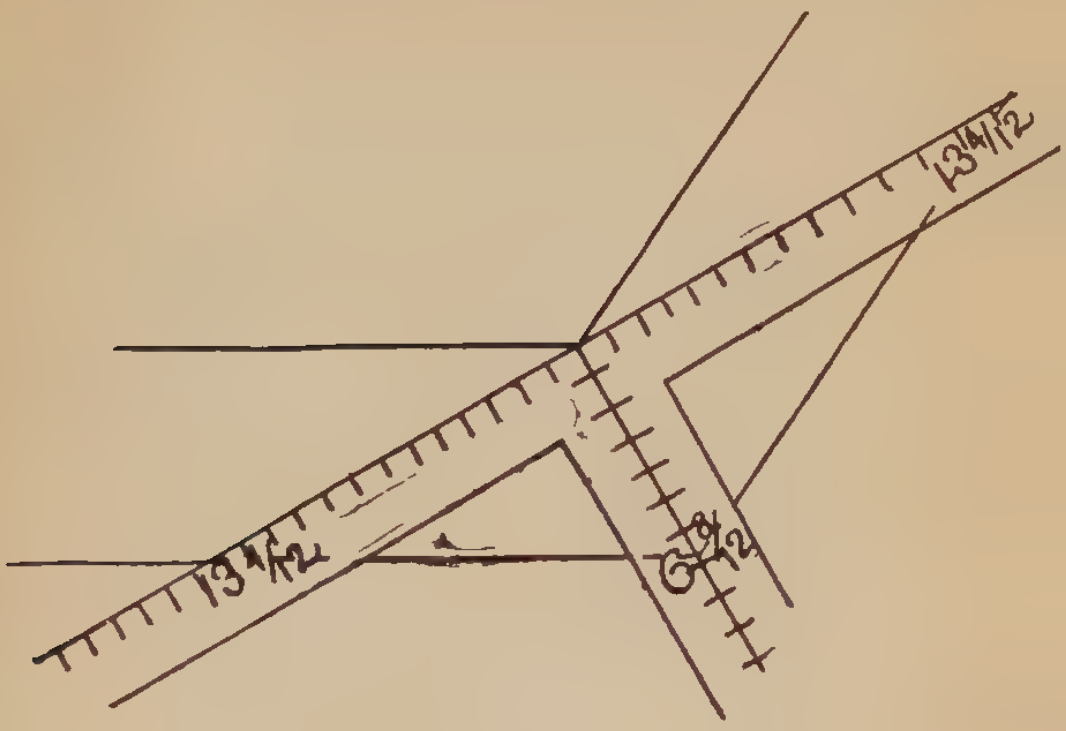


FIG. 73. FACIA CUT.

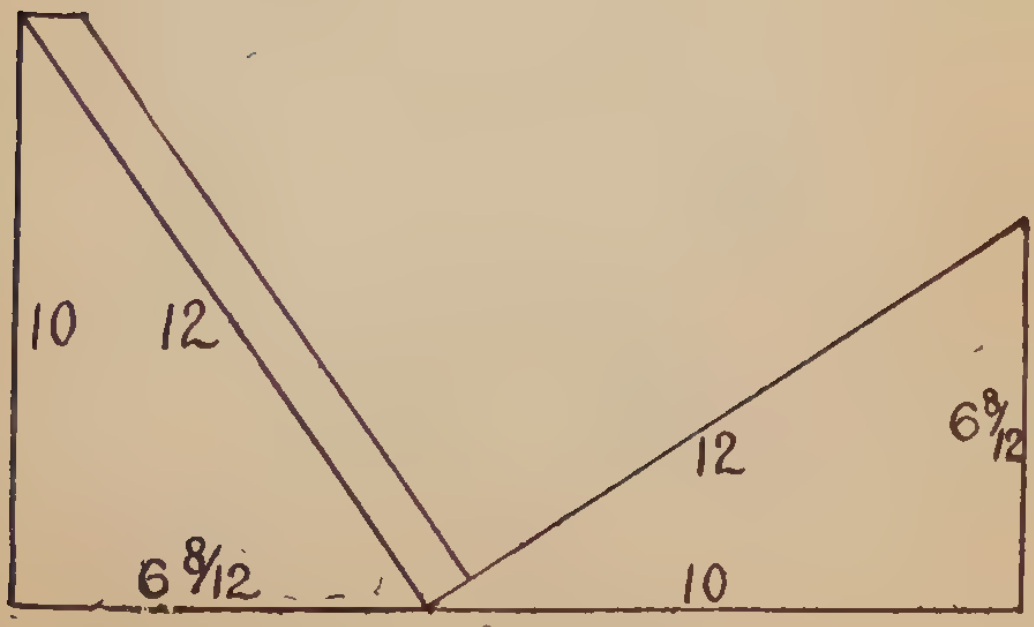


FIG. 74. HOPPER.

beveled at top to be level, then the side cut would simply be a square miter. I think the subject of hoppers will be practically covered by other examples of roof work, and needs no further explanation here. Only make a study of how roofs and hoppers compare, and I think the student will be able to figure out all the cuts he will ever come in contact with in hopper work.

Fig. 75. The valley rafter on an uneven pitch roof is a matter that should be considered. If the roofs are much different in pitch the plates must be different in height to come even at face of cornice, or the cornice must project more on one roof than on the other, etc., etc.

The valley rafter will not be at 45 degrees angle, therefore it cannot come at the angle at plate and cornice both, unless it can be cut on plate and swung around from plate to cornice at an angle of 45 degrees.

Fig. 76. To lap a rafter on a roof

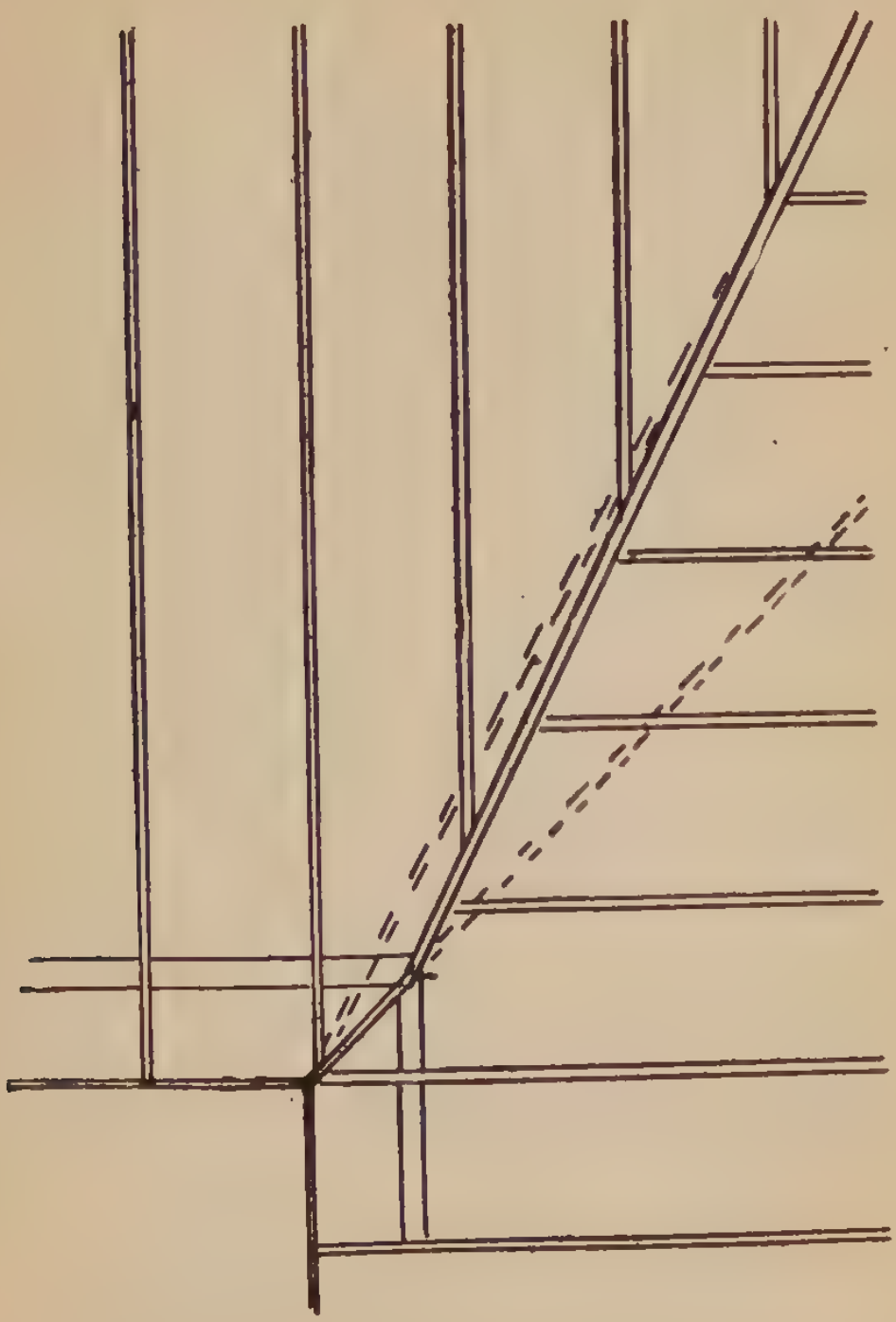


FIG. 75. UNEVEN PITCH ROOF.

of a steeper pitch, lay the square on the pitch of the lower roof, which will give

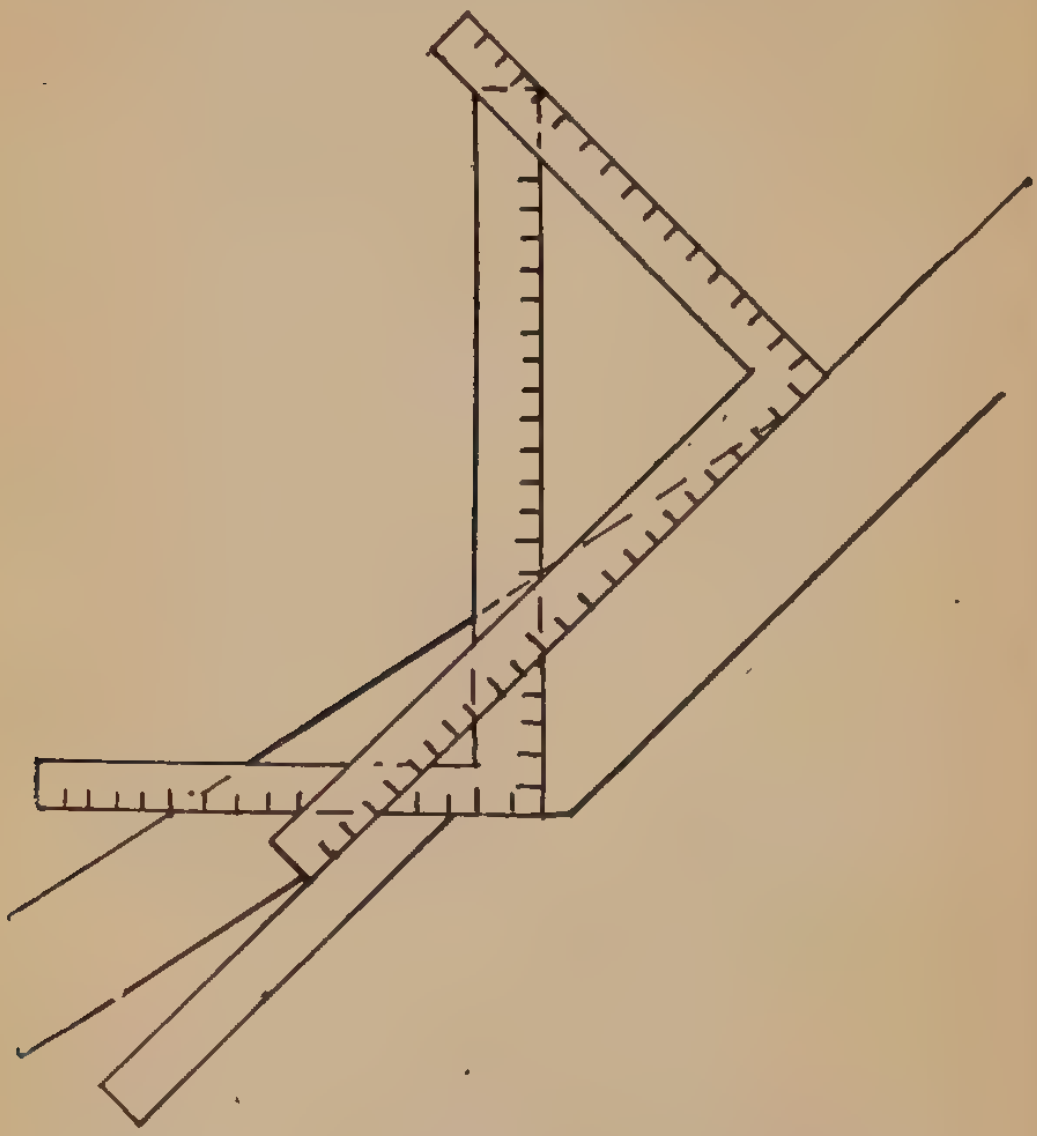


FIG. 76. LAPPING ONE RAFTER ON ANOTHER.

the plumb cut; from the plumb cut lay off the pitch of the upper roof, which will give the cut desired.

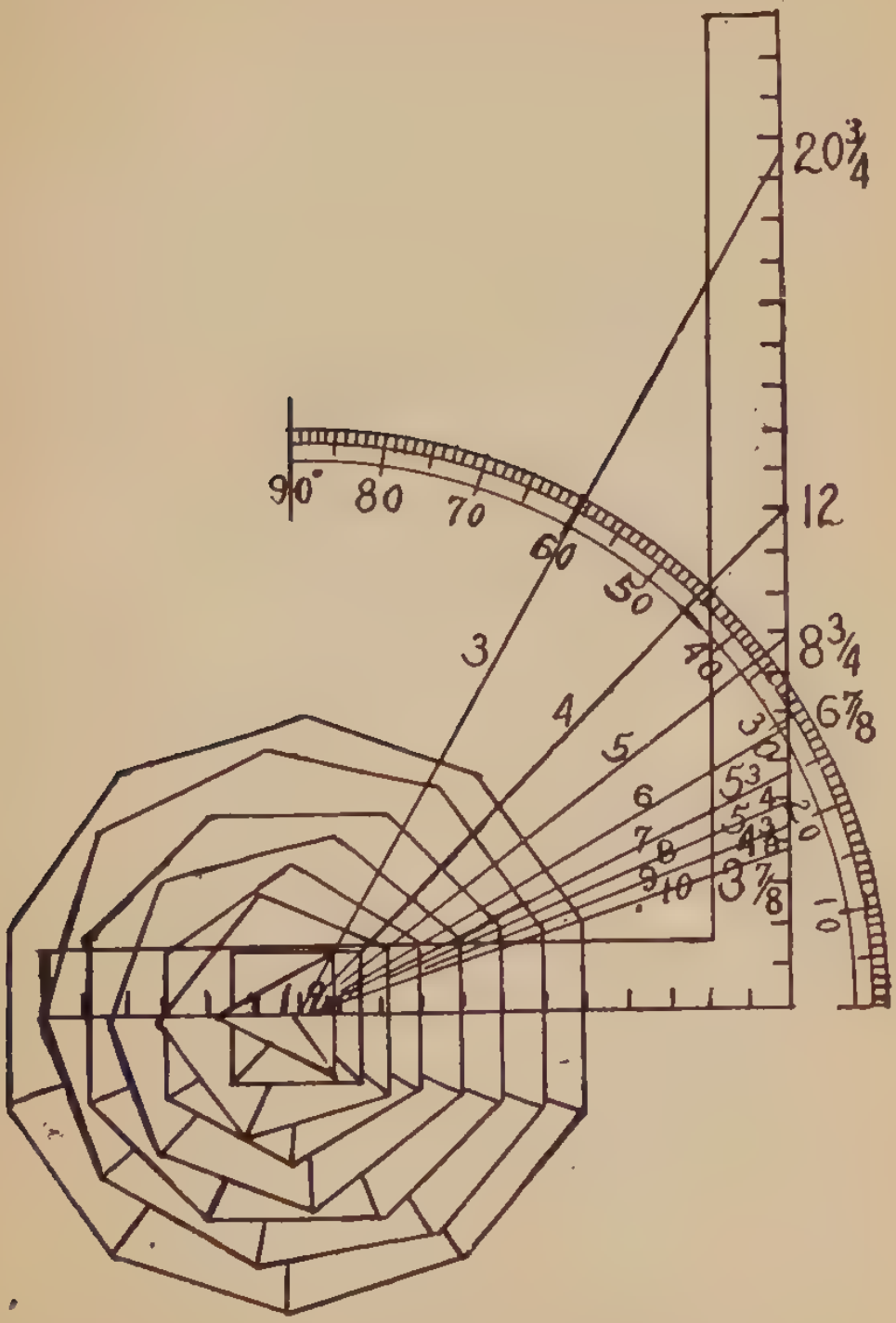


FIG. 77. POLYGONS.

Fig. 77. Polygons, the degrees, and cuts at angles, laying out of same, can all be figured out from this little illus-

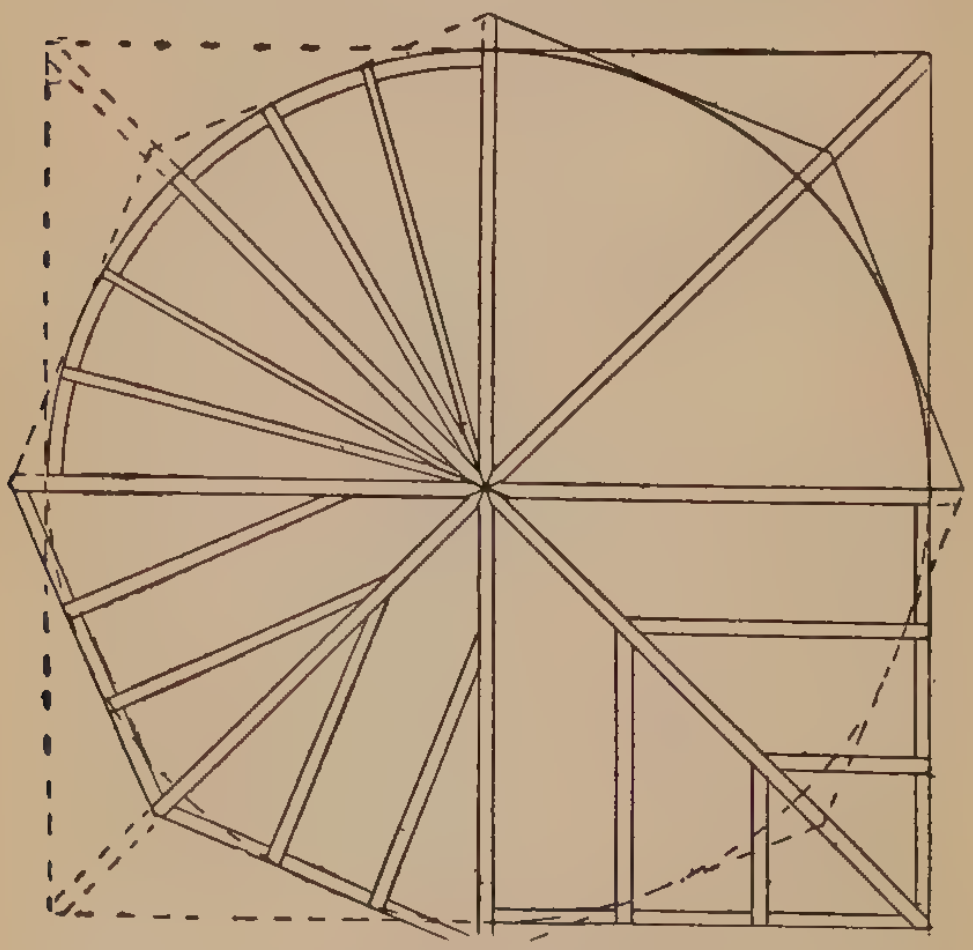


FIG. 78. CIRCULAR, OCTAGON AND SQUARE ROOFS.

tration, even if it is too small to give measurements smaller than 1/8 of an inch. Of course, some of the measurements are exactly accurate, and none

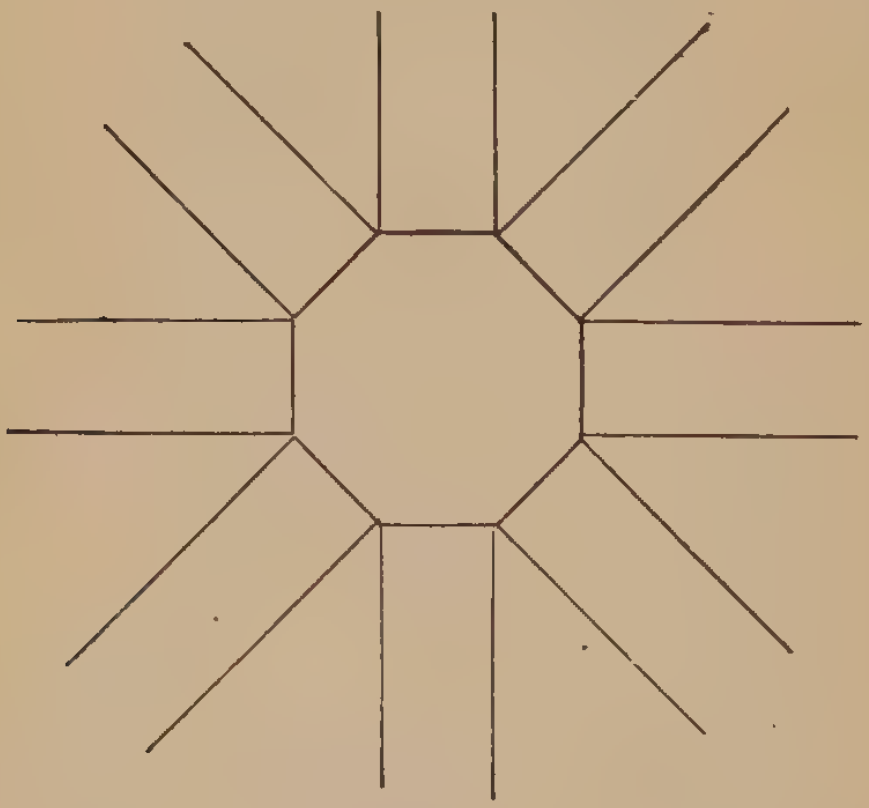
of them over 1-16 of an inch out of the way; therefore they will all be close enough for all ordinary purposes.

Fig. 78. Circles, Octagons, and Square Roofs. The upper right-hand corner shows how they compare; the upper left-hand corner shows manner of laying out circle roof with dotted lines showing position of octagon and square roof; the lower left-hand is octagon, while the other is square. As this plan illustrates a 12-foot tower, the run would be 6 feet, and to find the jacks for the square part, 2 feet apart, divide the main rafter into three equal parts; the long jacks in this instance are the length of the jacks for octagon.

Fig. 79. The roofs can be framed nicely with a 5-inch octagon pole in center, then the top of all the rafters are alike and there is no side cut, while the other plan shows them all alike and all having side cuts on each side.

Fig. 80. Still another way, and quite common, too, is to cut one pair

full length, and of course no side cut, as they come square together at top; then cut the next two just as much shorter as the thickness of the first two, and put them square against the first



FIG, 79. FRAMING WITH POLE IN CENTER.

two. Then the other four set in the corners, and the dotted lines show they should be as much shorter than the first as the diagonal of one-half the thickness, and have to be cut with bevels both ways, same as first plan,

although quite a different bevel, as there are four of these and eight of the others; of course, there are eight rafters in both plans, but whether eight or four are beveled of course makes a great difference in their bevels.

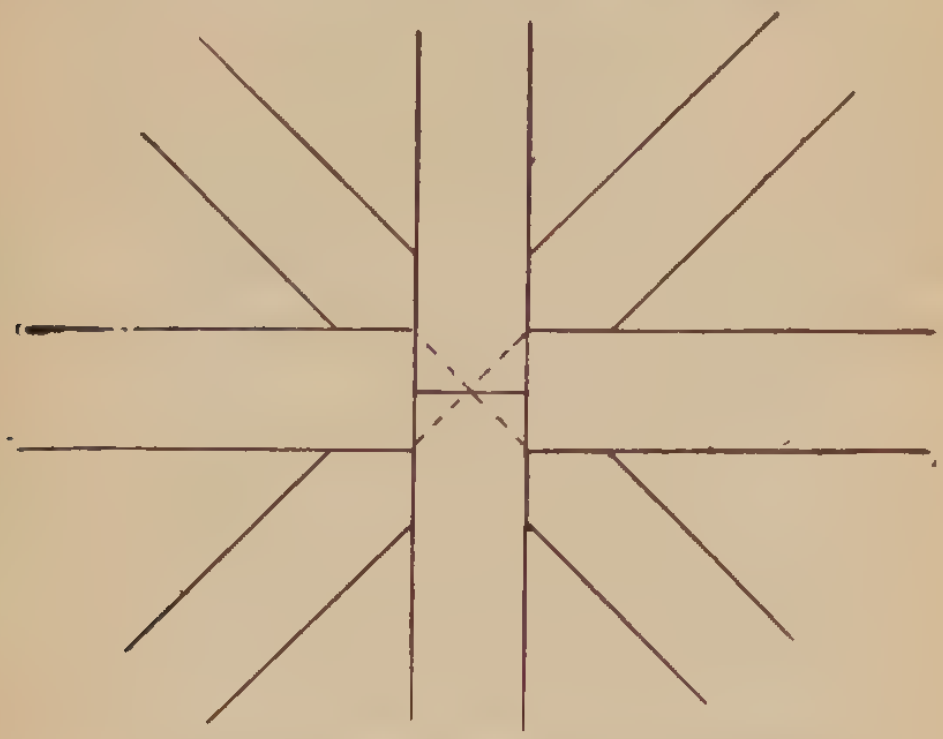


FIG. 80. OCTAGON RAFTERS.

On previous pages I have covered the subject of roof framing briefly yet quite completely, and most anyone that was really interested in the subject ought to be able to frame most any common roof. Yet I have no doubt

but a tower with round or ogee roof would be somewhat puzzling to some of the readers. Not only would it be difficult to get length of main rafters, but length and cuts of jacks; as the

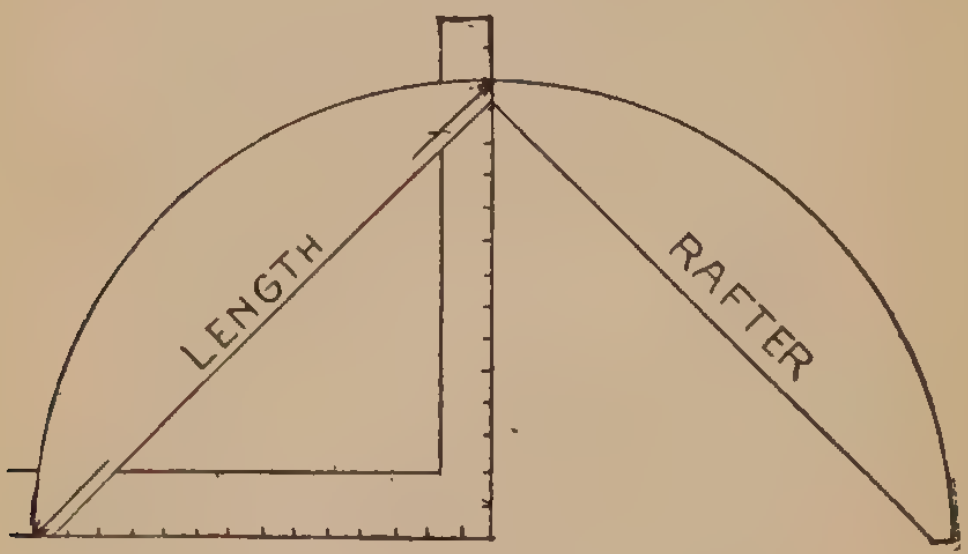


FIG. 81. CIRCLE RAFTERS.

top of the roof every part is a different pitch, there might be much to consider. In fact, there would be entirely too much to consider, to try to keep track of even half of it. Therefore don't try, simply take bottom edge of rafter and it is just as simple as any.

Fig. 81. Illustrates a very common roof for tower which is simply the top

half of a circle. Notice how the length is obtained just as easy as any roof.

Fig. 82. Shows a common ogee roof; the dotted lines show the top half to be as I just mentioned, while

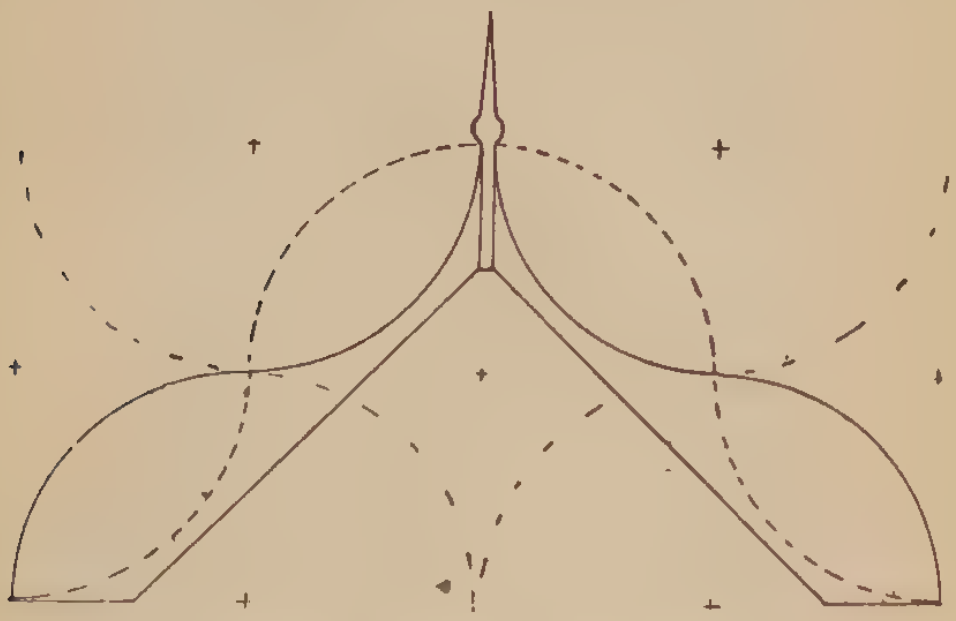


FIG. 82. OGEE RAFTERS.

the bottom half circle the other way and produce the ogee. The main lines show the ogee made the other way. They are all practically on the same principle and are formed as the first illustration of parts of circles. I have made a little cross which shows the

centers, and continued to swing around with the dotted lines to make it plain.

Fig. 83. Curved roofs are made all manner of ways, yet almost always are made either to circle down or circle up, or to circle down and up or up and down. It matters not which way; they are all handled in same manner.

To cut a ½ pitch ogee rafter for the roof just mentioned: As it is just a little too long to use the square direct, drive a nail just 3 feet from end of stick and swing it around; mark with a lead pencil and cut the upper one out and nail it on the bottom, and it makes the ogee rafter complete; or if cut out of a wide enough piece and you wish it whole, use the 3-foot stick at bottom same as top.

Remember, the rise for hip is same as main rafter—the difference is in run only; not only is the rise the same at the extreme top, but it is the same at every point; therefore lay off run for ordinary, octagon, or any other hip,

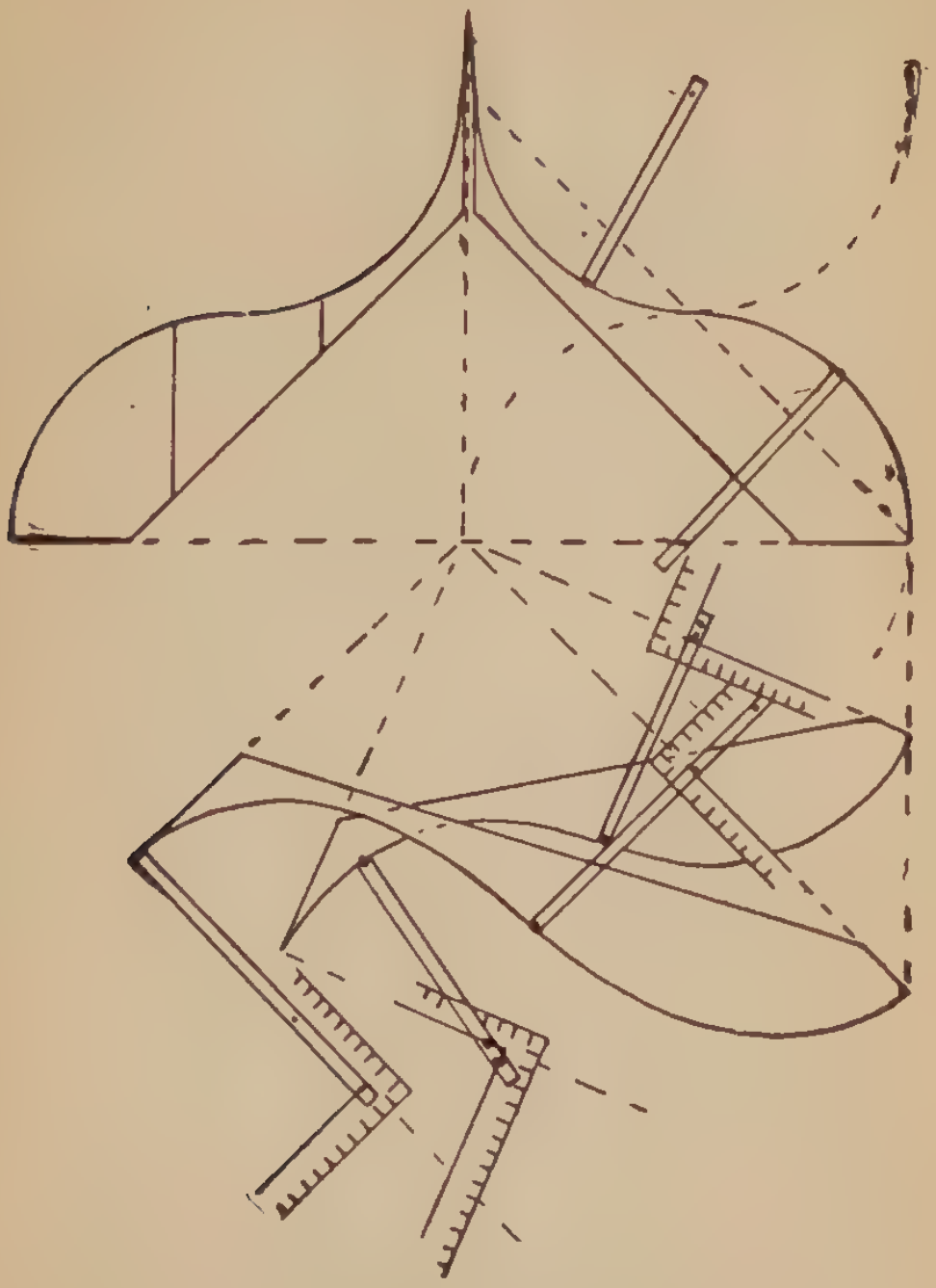


FIG. 83. CURVED RAFTERS.

and put a nail in a stick half its run, and another same as for main rafter. Place the square as illustrated, swing your stick around, and you will readily see how easy it is to lay out an ogee hip to fit an ogee main rafter. The square and stick are much more convenient, quicker, handier and more accurate than the old-time intersecting line method.

This illustration is the first one I ever saw of this method, and while it is entirely my own as far as I know, yet I would indeed be sorry if others had not applied it for ages. I think the illustration is too plain to need any further explanation.

Main rafter above, octagon and square hip below, while the one at left shows length of jacks.

Hexagon and other polygons are practically the same principle as octagon work.

Fig. 84. The cut at angle of hexagon is 14 and 8; cut on 8. The corner (or to cut to lap) is the same.

Fig. 85. To lay off rafters, especially a curved roof, it is a good plan to

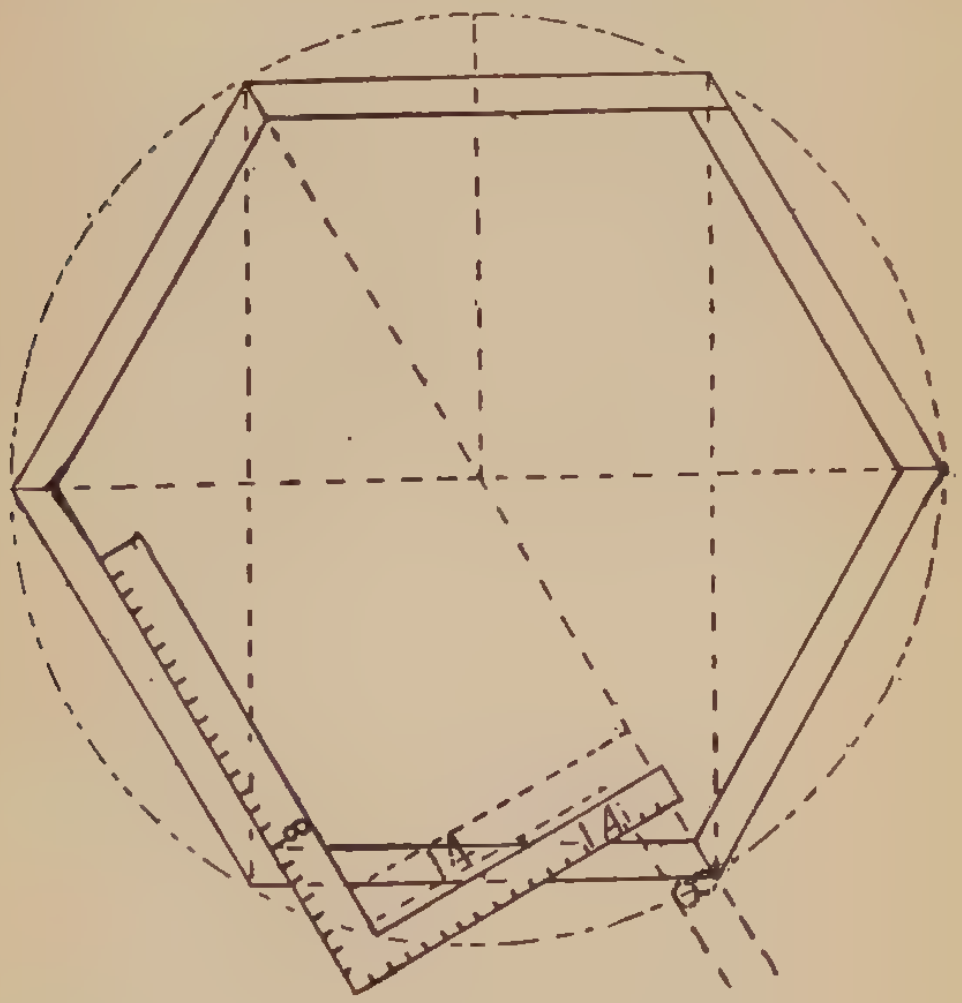


FIG. 84. HEXAGON.

take a 1 by 4 for pattern. As the run and rise are both 6 feet, lay the square on 1 foot six times and it gives length and cut of main rafter.

Fig. 86. As octagon run is practically 1 inch more to every foot than main, apply the square at 13 inches

FIG. 85. MAIN RAFTER.

for run and 12 inches for rise six times, and it gives length and cuts of octagon rafter.

FIG. 86. OCTAGON RAFTER.

Fig. 87. For hip rafter use 17 inches for run, which is accurate

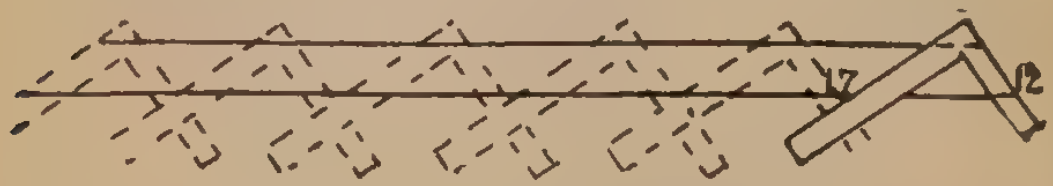


FIG. 87. HIP RAFTER.

enough for ordinary purposes, though 17 inches is nearly 1-32 of an inch too long.

Fig. 88. The line or mark at the right shows the top of full length rafter to come together at center.

To cut a pair to fit against the sides of the first pair, measure square back (not down the edge of rafter) half the

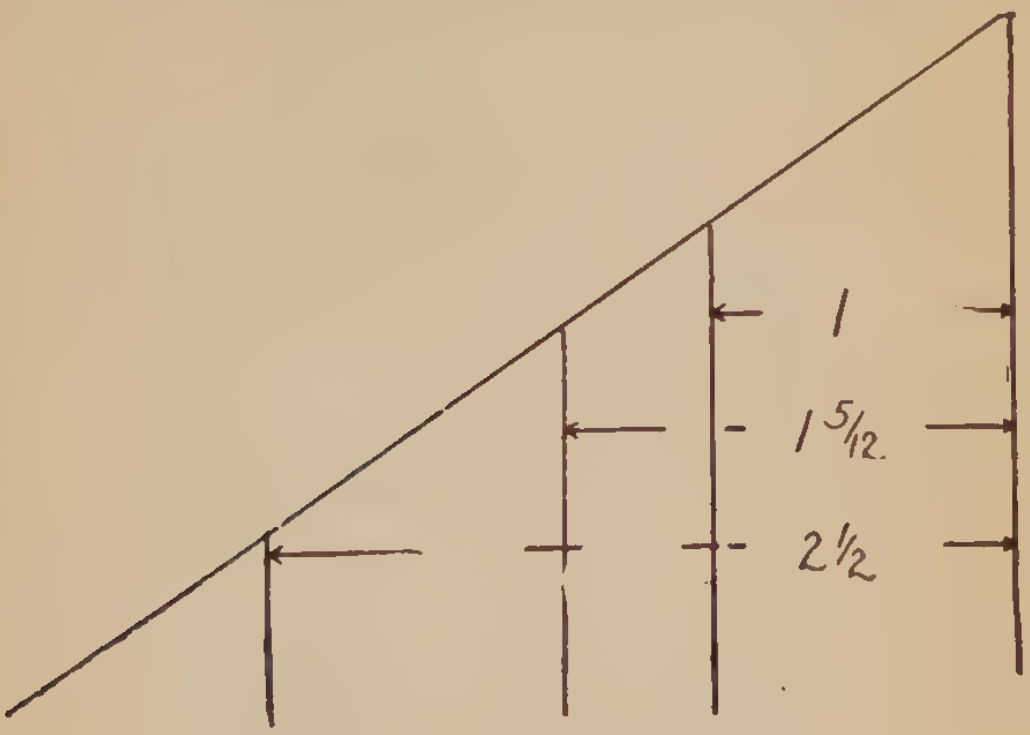


FIG. 88. TOP OF RAFTERS.

thickness of rafter; if the rafter is 2-inch stuff, as it generally is, the measurement would be 1 inch. Then for rafter to fit in the corners made by these four rafters, measure across 1 inch at an angle of 45 degrees, and we

find 1 5-12 inches is what that rafter is shorter than full length rafter, or first pair. To fit against 5-inch pole, measure back 2½ inches, measure back 2 5-12 inches to mark the side to cut to, where they are all cut full length, and side cut both ways as shown in plan of roof. The measurements could just

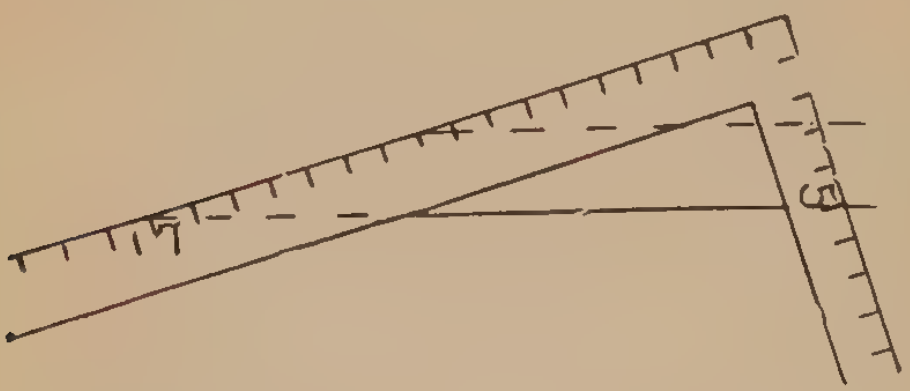


FIG. 89. SIDE CUT OF JACK RAFTER.

as well be calculated by measuring down the edge of the rafter, but it is not as simple, as the pitch of roof has to be figured on all the time.

Fig. 89. Side cut of octagon jack is 5 inches to length of 1 foot run of main rafter, which is 17 inches on a ½ pitch roof, or 17 and 5; cut on 17.

For curved rafters lay off side cuts

from the bottom, as there are too many pitches to keep track of on the top.

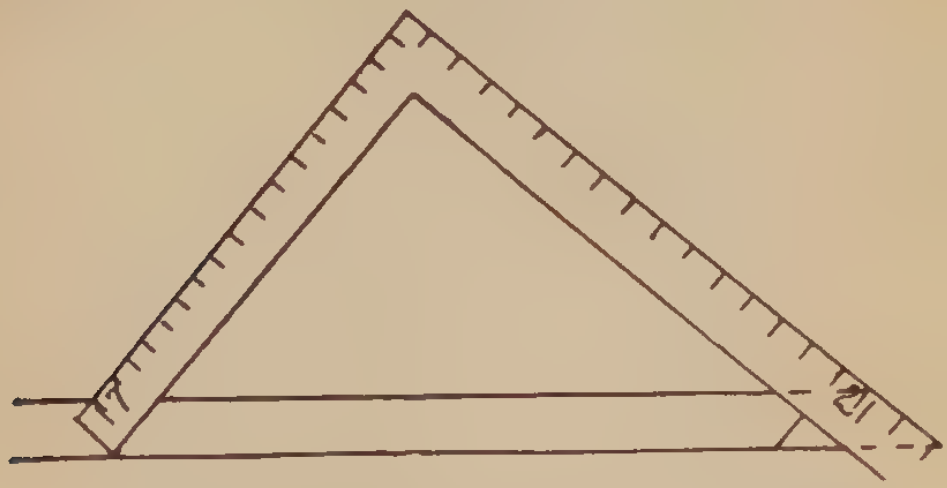


FIG. 90. SIDE CUT OF HIP RAFTERS.

Fig. 90. The side cut of hip is length of hip and run; cut on length.

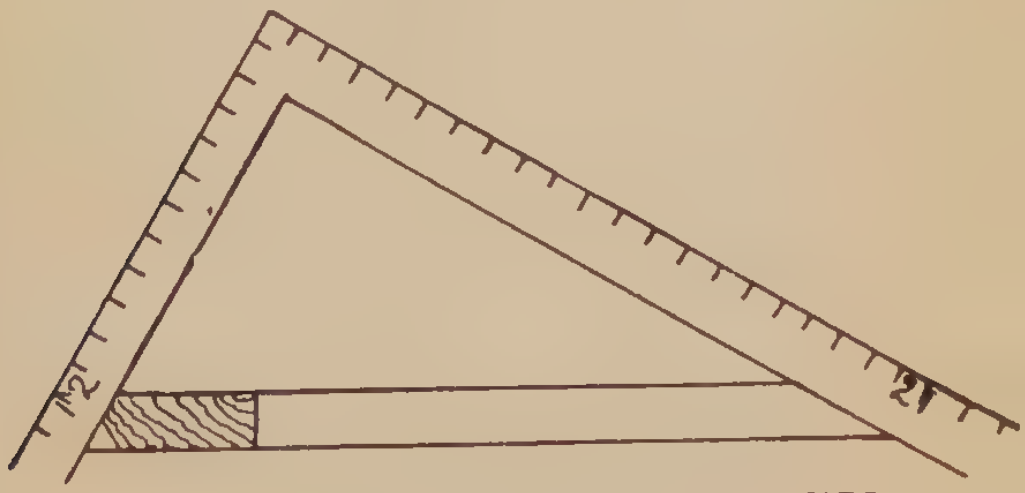


FIG. 91. BACKING OF HIP RAFTER.

Fig. 91. To back the hip on top take rise and length; cut on rise. For octagon hip, ½ is the old rule, though

5-12 is more accurate, yet either is near enough for practical purposes.

(I show 21 on square, though the actual measurement lacks 2-10 of an inch; however, 21 is near enough for ordinary cuts.)

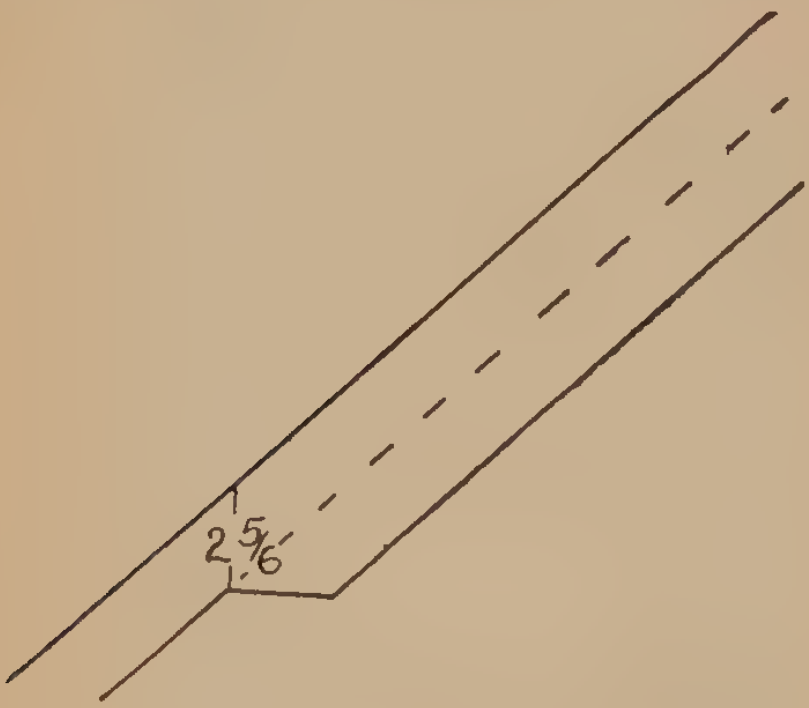


FIG. 92. FOOT MEASUREMENT.

Fig. 92. Where the rafter projects over the roof, as most rafters do, the measuring up of the heel should be considered. And when the top has to go to a given height, as in porch roofs to come under cornice, or second-story

window-sills, etc., very accurate measurements should be made and the heel allowed for so to be sure to have it correct.

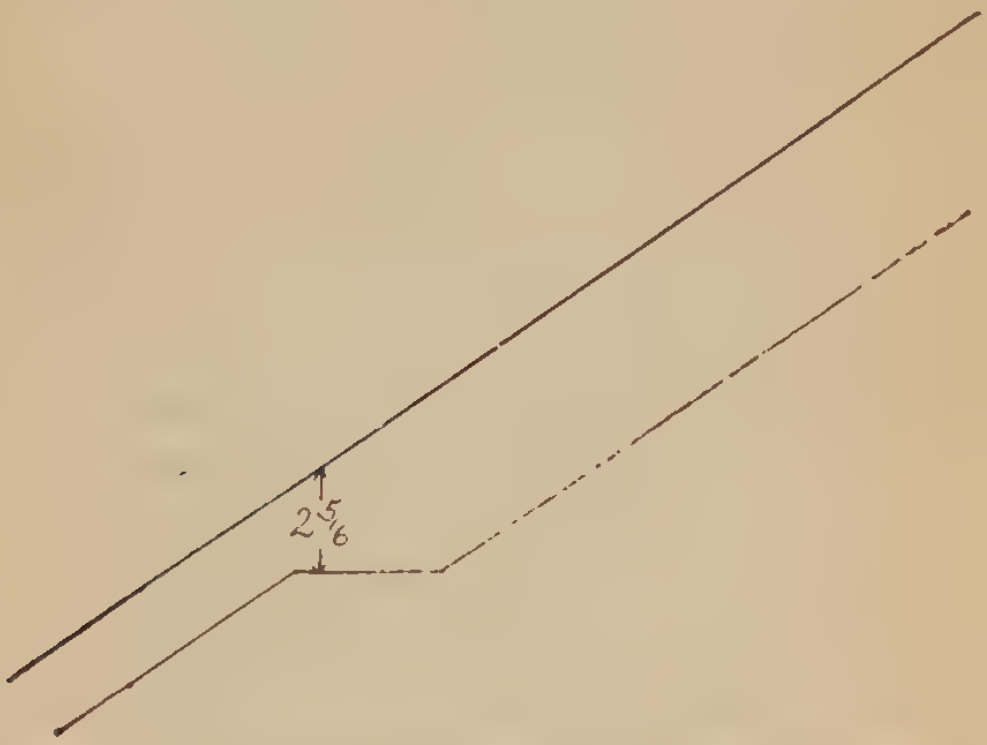


FIG. 93. FOOT MEASURE OF HIP RAFTER.

Fig. 93. The measuring up of hip and valley should correspond with the common rafter, a matter that many good mechanics do not seem to understand, or at least are too careless about. It should be measured up the same as common rafter. Not at notch in rafter but at edge of plate. See illustrations.

Fig. 94. I have already explained how to get length of jacks for different roofs. I'll now explain here one more, and also explain why it is necessary. Once I was working on a very large house that didn't have a common rafter; they were all hips, valleys and jacks.

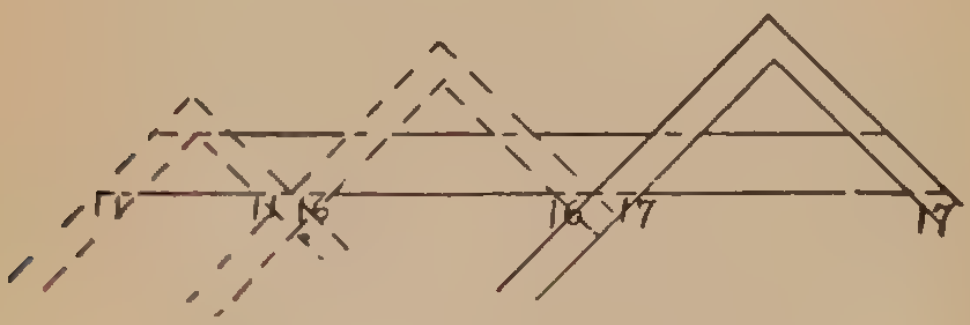


FIG. 94. JACK RAFTERS.

The hips and valleys were up when I commenced to work, with a crowd I had never worked with before; but the contractor had read an article I had written on jack rafters, so the first job he gave me was to cut and put up the jacks. (By the way, it was the only roof I ever cut in the attic; all others I have cut on the ground.) This roof

projected about four feet, and every jack rafter had to be cut exactly over every studding. It was ½ pitch roof, and as the first jack wanted to come over the first studding from corner,

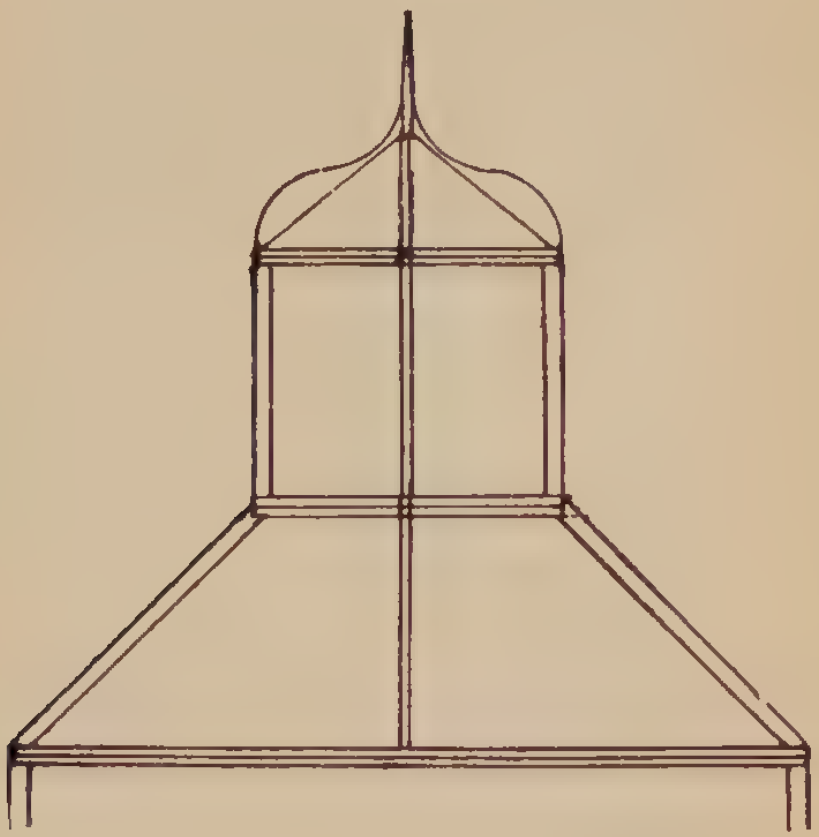


FIG. 95. ELEVATION OF ROOF.

which was only 11 inches, I placed square on 11 inches and 11 inches and it gave length and cuts of first jack; marked that measurement on the piece to cut next jack, which was then the

regular 16-inch space; placed the square on 16 and 16, which gave the next; as the next studding to the window was 17 inches from there, from that length lay on square at 17 on both

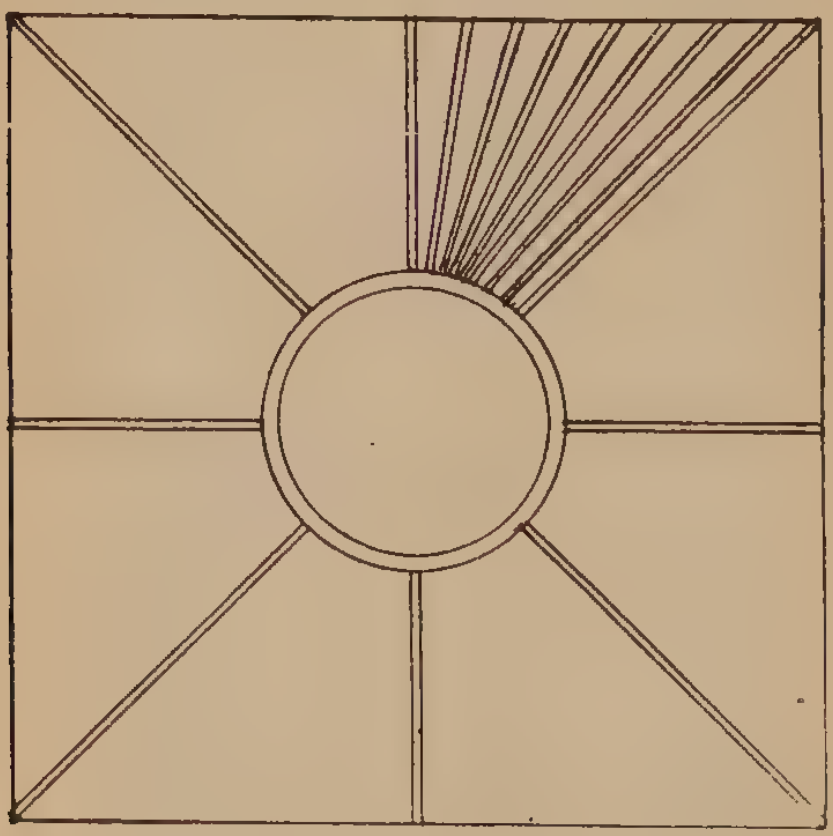


FIG. 96. PLAN OF ROOF.

tongue and blade, as it was a ½ pitch roof, and it gave third, and so on.

Fig. 95. Elevation showing how the circle tower and ogee rafter we

have just been telling about would look on top of a big square building.

Fig. 96. Plan of same to cut these rafters. At first it might look like a difficult job indeed, but the run and rise will cut the main and hip just as easy as on any roof, and with those cut it is easy to get the other seven; with these as patterns the roof becomes just as easy as any roof; in fact, when we fully understand it, all roofs look alike, anyway. Very difficult matters, when fully understood, often become very simple indeed; and now that books are published on almost every department of carpenter's work, it is an easy matter to get any information required. The Industrial Publication Co. of New York make a specialty of books for carpenters and will send a descriptive catalogue to any reader who applies for it.

Fig. 97. Shows the laying off of a twelve-foot building, or six-foot run, which is simply to place one foot on blade and the number of inches that

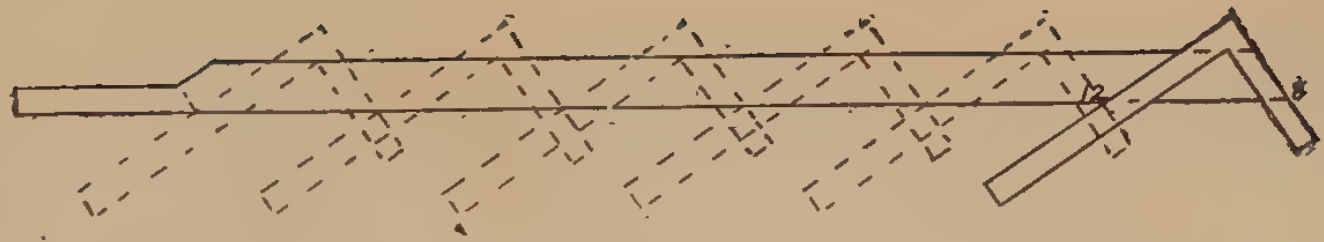


FIG. 97. LAYING OFF 1-3 PITCH.

FIG. 98. USING CENTER LINE.

FIG. 99. LAYING OFF 1-3 PITCH HIP.

the rise is to the foot on tongue and apply the number of times there are feet of run.

If applied by using the edge of rafter, always remember the measuring up of heel.

Fig. 98. Shows a rafter being laid off by first making a line through the center and working the square to the line instead of edge of rafter, and in that way there is no measuring up of heel.

This shows an octagon rafter to go with a roof, where Fig. 97 shows a main rafter, which is just the same, only use 13 in place of 12 on blade.

Fig. 99. Shows common hip or valley, which is the same as the others, only use 17 on blade. Why 17 is used I will try to make plain in the following illustration:

Supposing this run, instead of 6 feet even, was 6 feet 7 inches.

Fig. 100. Shows the application, which is simply to place the square on

just the same as if laying off another foot, then mark a guide line at the edge of the blade and bring the square down to 7 inches. A mark at edge of tongue gives length of rafter, which shows that fractional part of feet is just as easy as even feet. But, of course, when

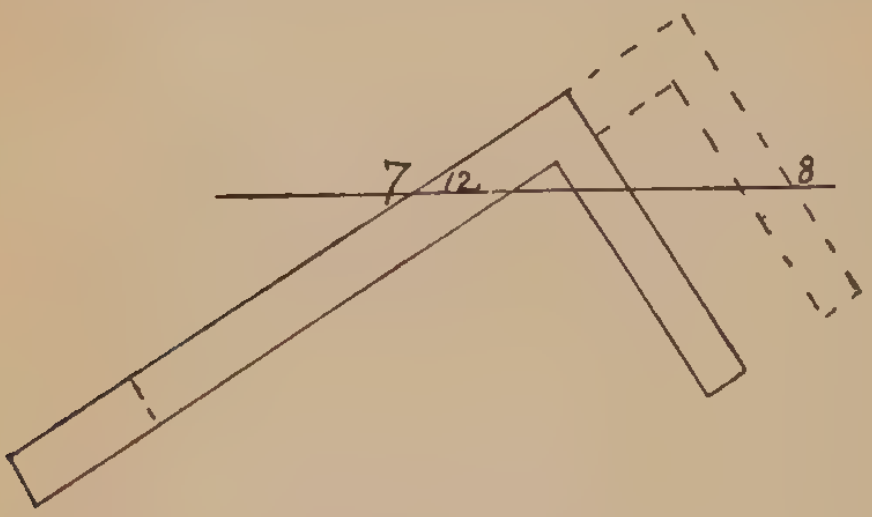


FIG. 100. FRACTIONAL PART OF FEET.

we get to octagon and hip, it is a little different proposition, and many mechanics would get out their pencil and figure it out, and some mechanics perhaps could not even figure it out at all. It is a very simple example in proportion. As 12 is to 7 so is 13 to——.

Fig. 101. Shows it, which is practi-

cally 7⅝ inches, while 9⅞ inches, strong. In laying off the rafter, make it just as strong as you found it to be.

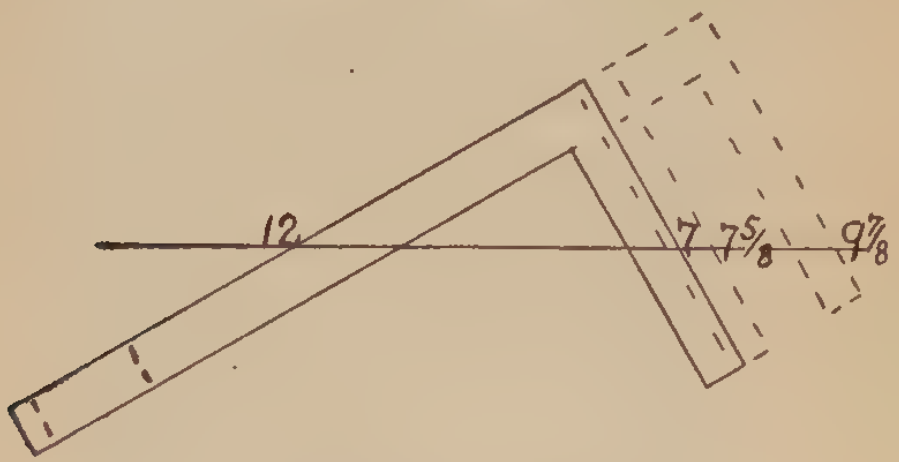


FIG. 101. GETTING FRACTIONAL MEASUREMENT.

I think the illustration shows plainly how it is done. Simply put your square

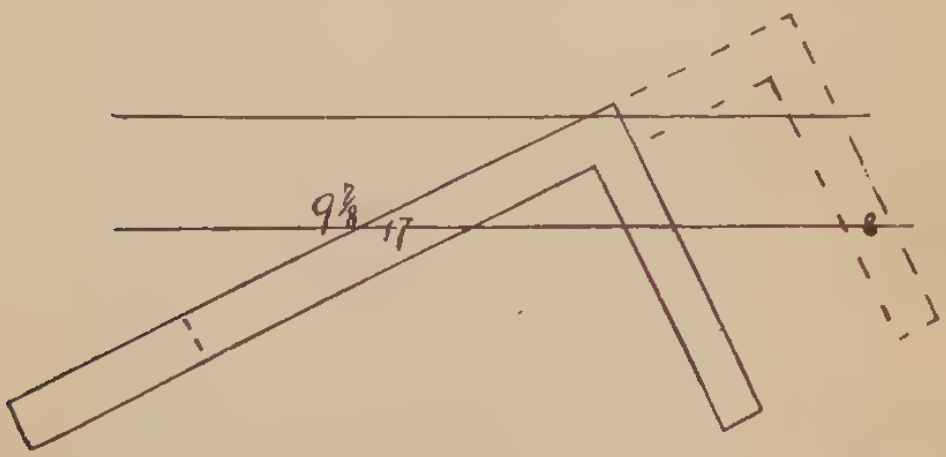


FIG. 102. FRACTIONAL HIP MEASUREMENT.

on 12 and on 7 (or any fraction you may wish to find); then move the

square up to 13 for octagon, and tongue gives it. Move square up to 17 for hip, etc.

Fig. 102. Shows how to apply hip measurement, which is simply to place the square on for regular hip work and then move the blade down to the number just found, and tongue gives length and plumb cut.

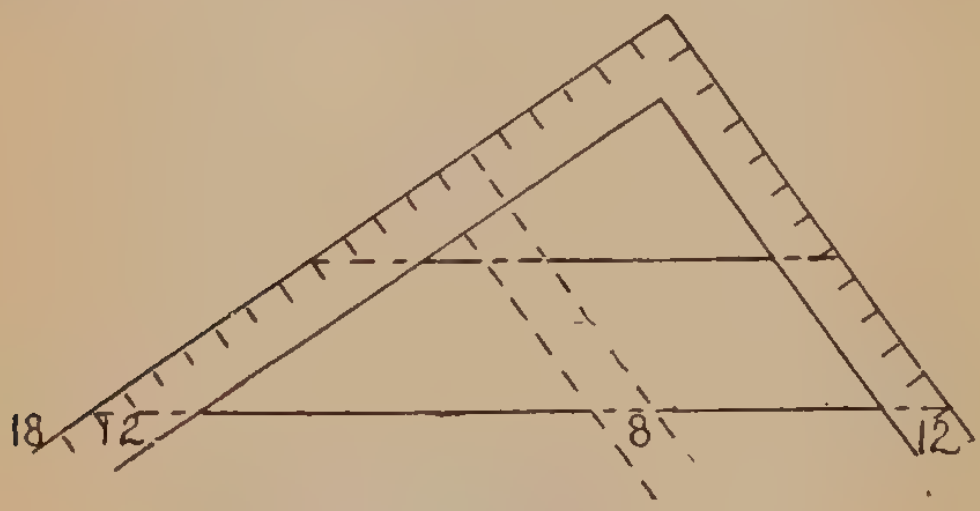


FIG. 103. MEASUREMENT FOR JACK RAFTERS.

Fig. 103. For a ⅓ pitch roof and jacks spaced 18 inches apart, place the tongue of square on 8 inches (rise to one foot) and 12 inches on blade, which gives ⅓ pitch; move the blade up to 18 inches and it gives length of first rafter; apply twice for second, three times for the third, and so on.

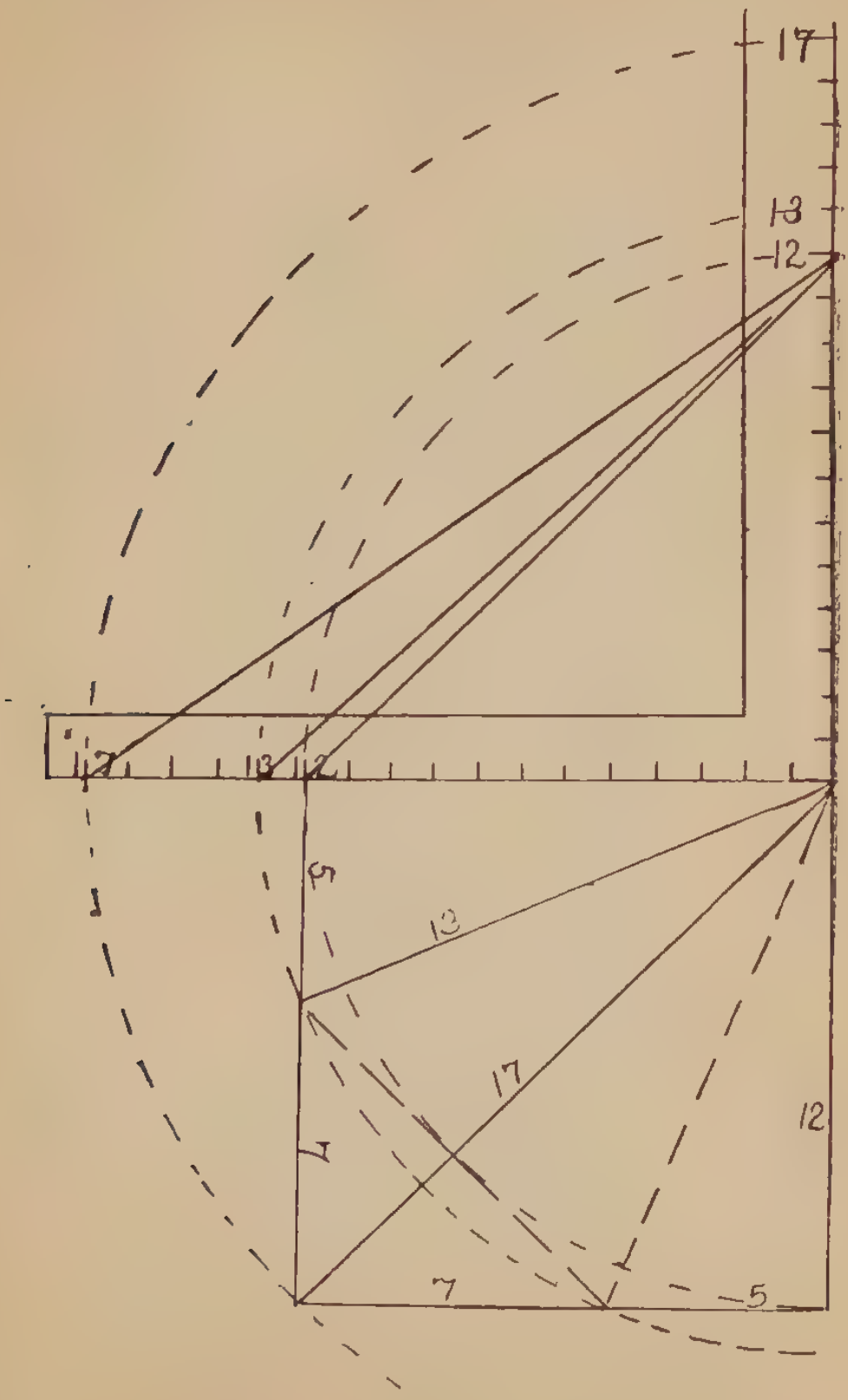


FIG. 104. RUN OF HIPS.

Fig. 104. I have tried here in this to illustrate why 5, 13 and 17 play such

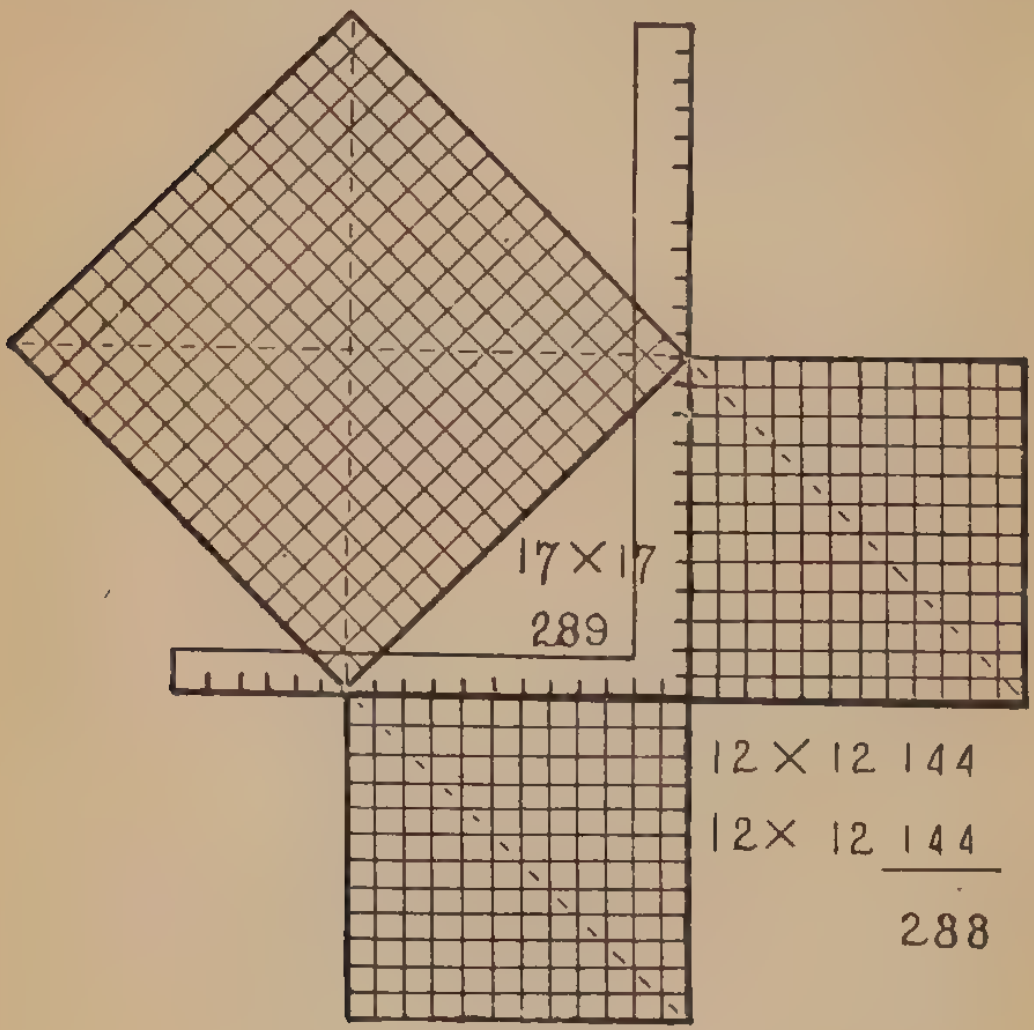


FIG. 105. DIAGONAL OF 12.

an important part in octagon and hip roofs. I think the illustration needs no further explanation, but should receive more than a passing glance; the reasons why should be considered.

Fig. 105. I have here tried to make it plain that while the diagonal of 1

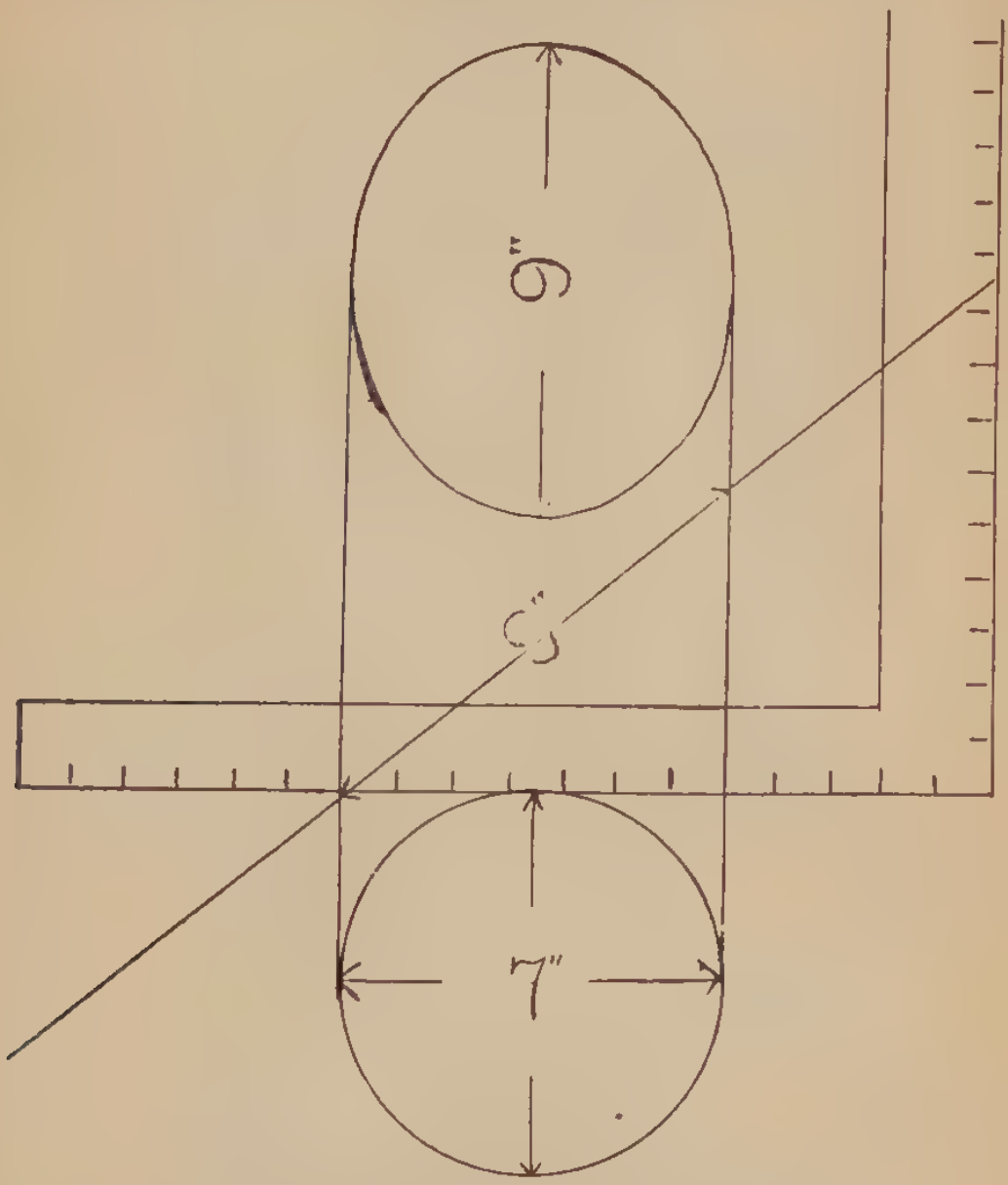


FIG. 106. PIPE THROUGH ROOF.

foot is practically 17 inches, it is not quite, but how near? It is simply larger by just one little square. (This

shows the comparative size of squares also, which I'll mention again.)

Fig. 106. To put a 7-inch pipe

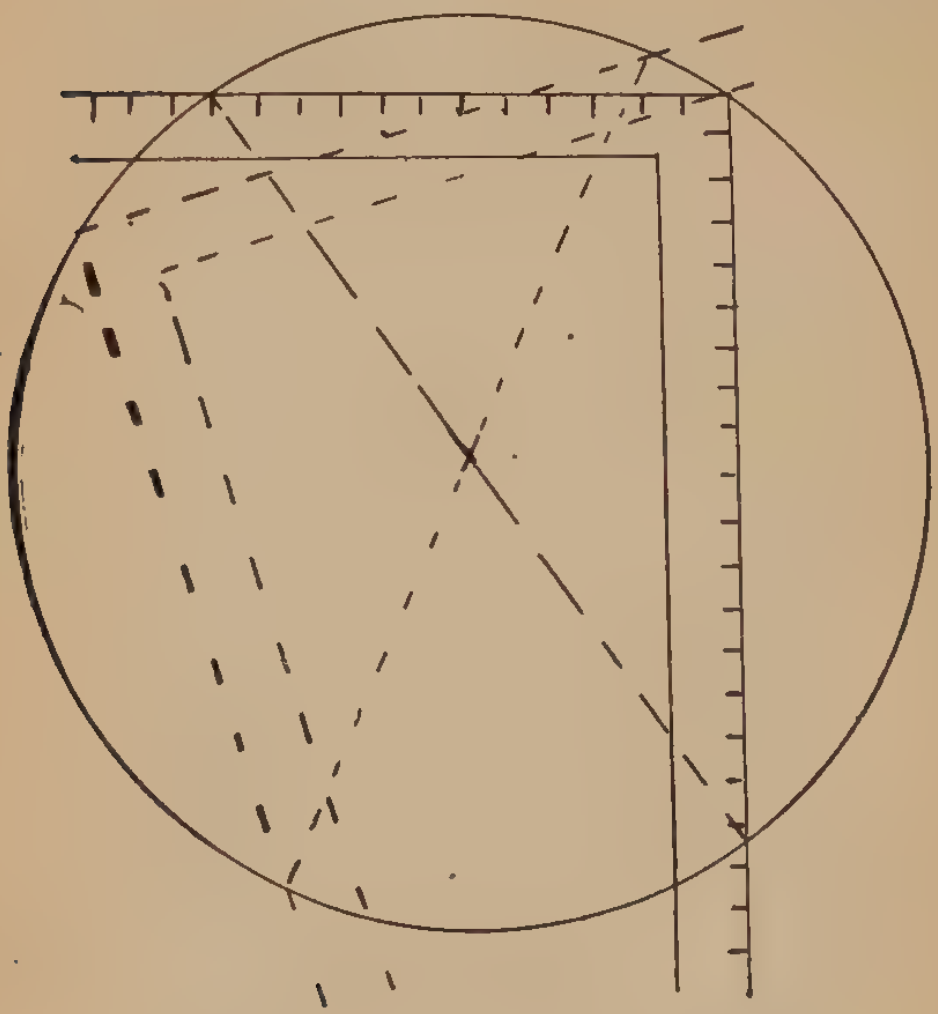


FIG. 107. CENTERING CIRCLE

through a house, cut a 7-inch circle through floors, ceilings, etc., and measure across 7 inches the pitch of the roof; if it measures 9 inches, cut 9

inches up and down on the roof and 7 inches the other way.

While this is quite simple, yet many mechanics would not know how to do it, and realize that the hole through the roof is a perfect ellipse. It would be well to give this more than a passing thought.

FIG. 108. CIRCULAR ARCH.

Fig. 107. To center a circle, simply place the square on and let the heel touch, and where the other parts strike the circle center the line joining them, and that gives it. Or place the square on twice, and where the lines cross is the center.

Fig. 108. Shows an arch made of a part of a circle and to find the radius of such an arch might take some guess-work by some methods, but the square masters it accurately.

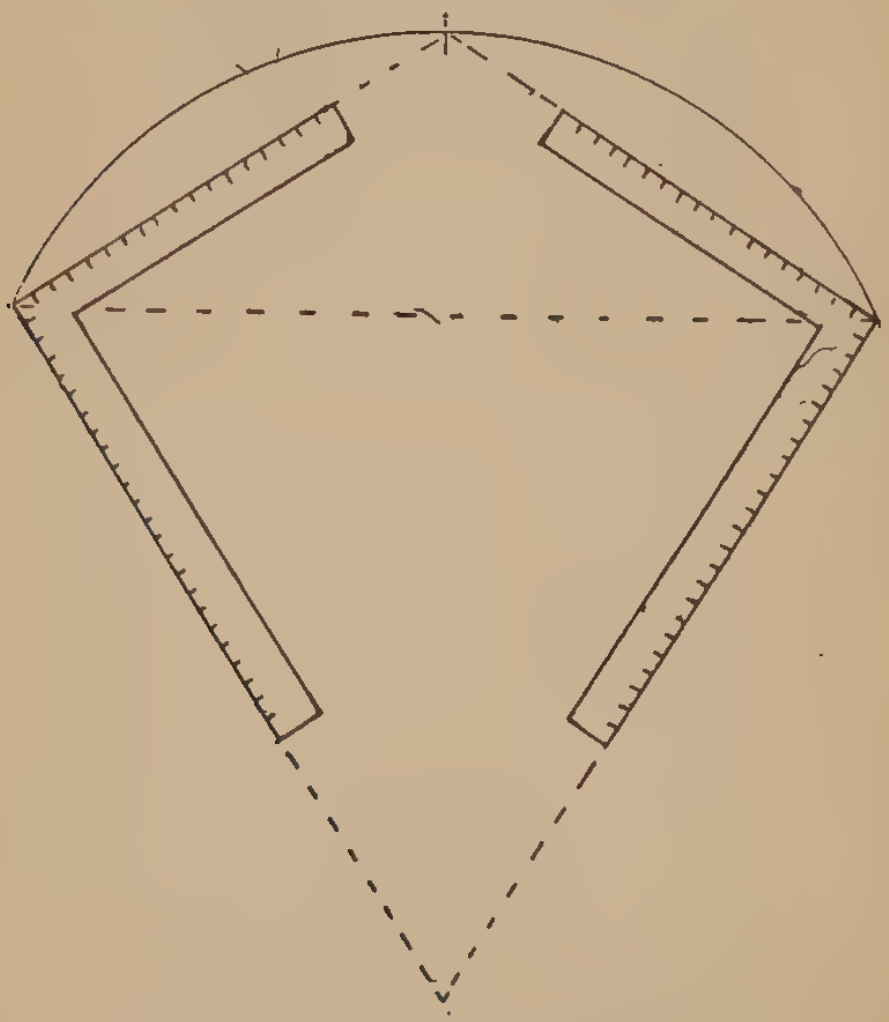


FIG. 109. FINDING THE RADIUS.

Fig. 109. Shows that the square laid on a line with the top of the arch and at the bottom edge, and then re-

versed, that where the lines cross is the other, or bottom edge of circle.

Fig. 110. The center of the top and bottom of a circle is, of course, the radius.

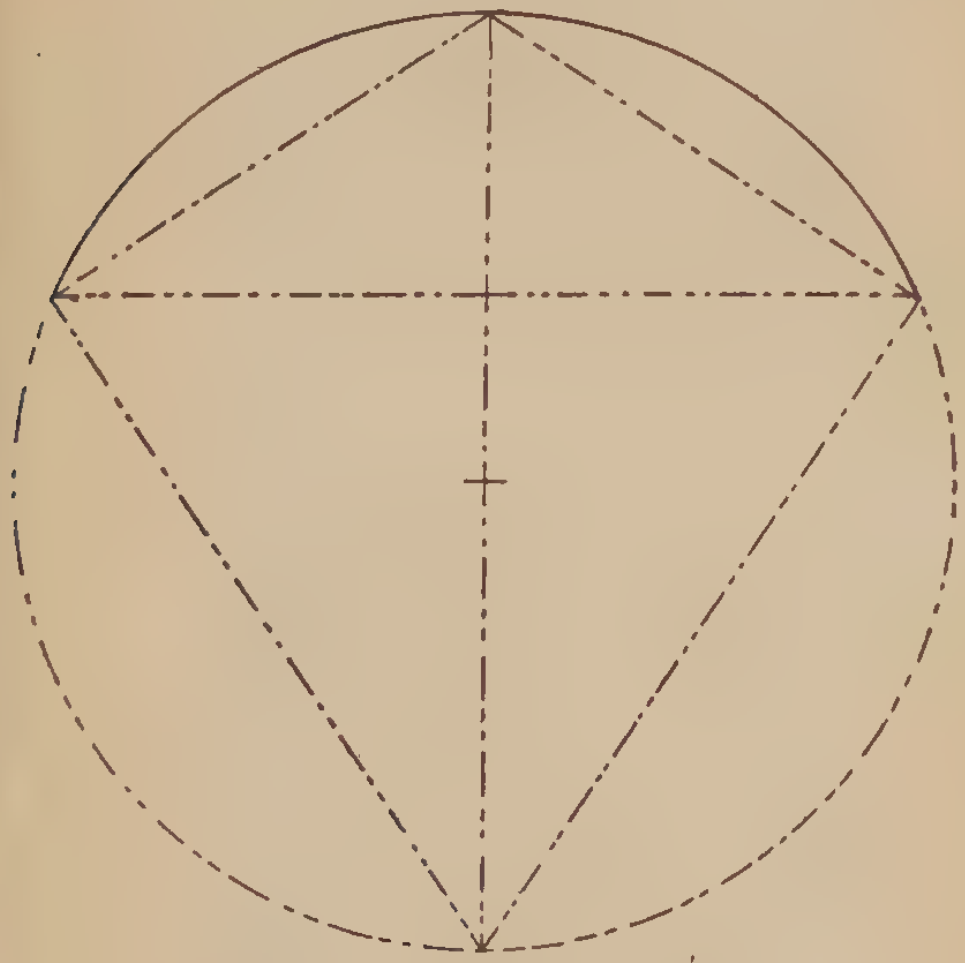


FIG. 110. RADIUS FOUND.

Fig. 111. To find the diameter for large circle to contain the same amount as two smaller ones, measure across the

square at the two small diameters, and it gives the diameter of the large one.

Fig. 112. To find the size of square to have ½ as much area as the other,

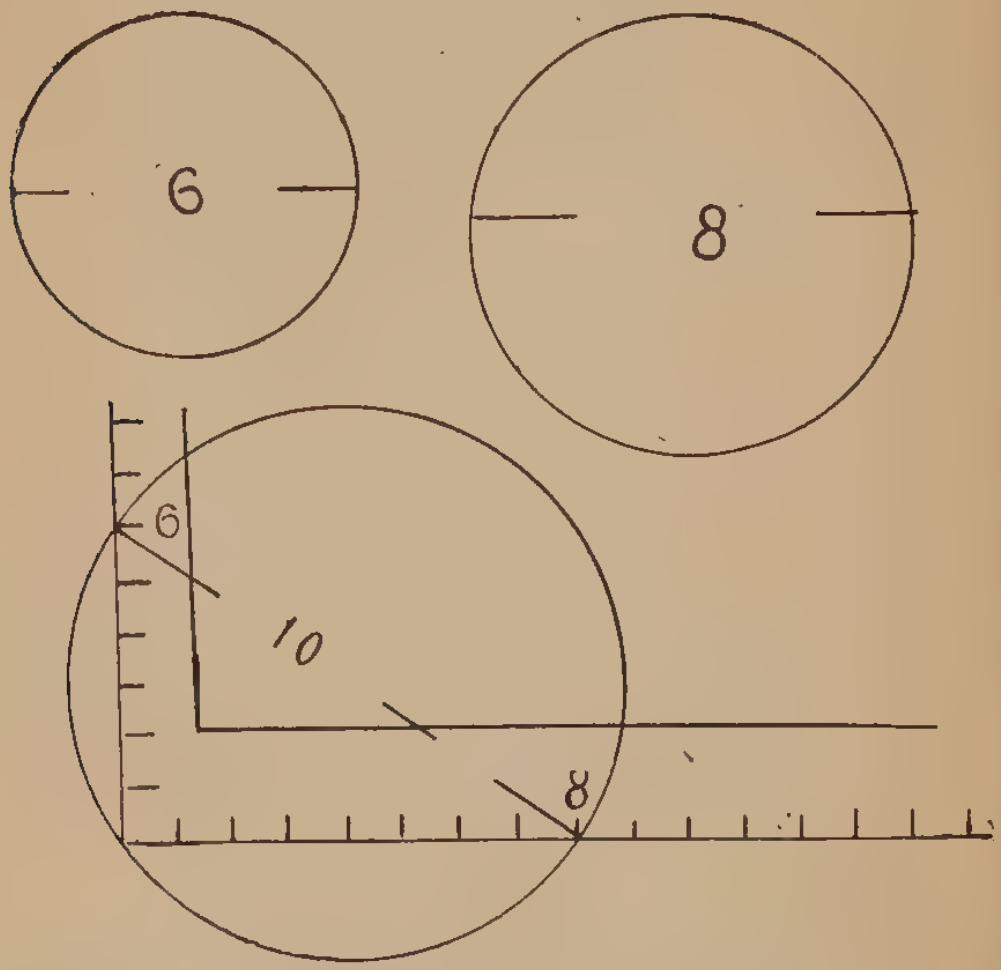


FIG. 111. CIRCLE SIZE OF TWO CIRCLES.

take ½ the diagonal measurement of larger square for side of smaller square, or if the square is to be twice as large as the first, take the diagonal

measurement for sides of square, and so on; there is practically no end whatever to these circles and squares.

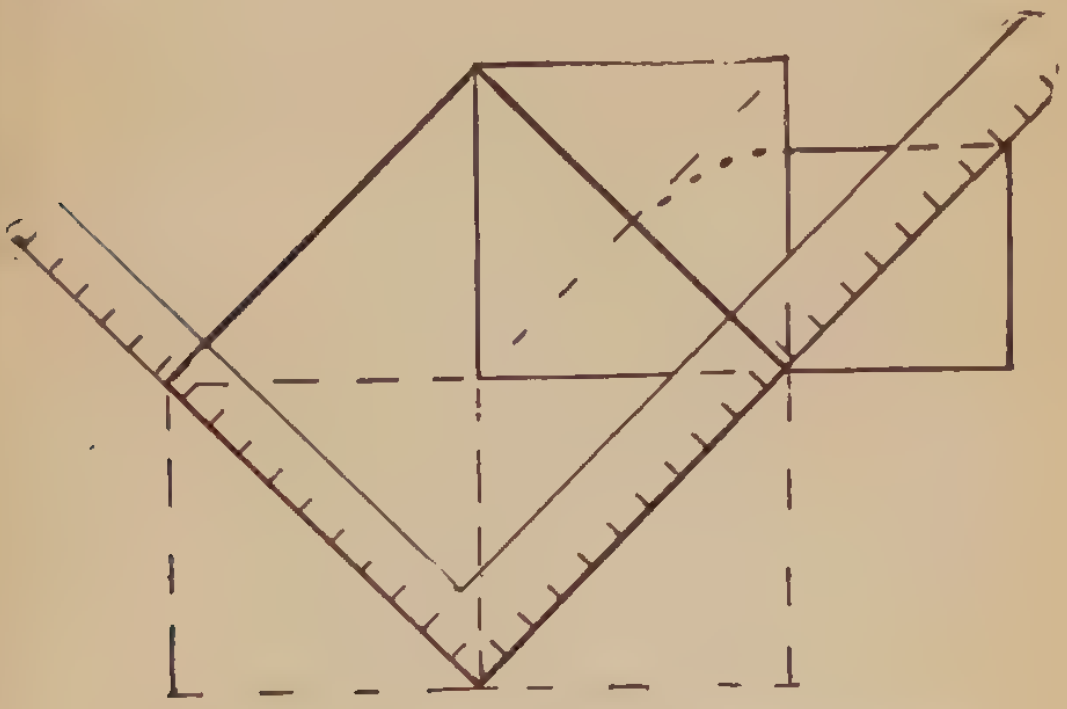


FIG. 112. DOUBLING SIZE OF SQUARE.

Fig. 113. To divide a cone into two equal parts is indeed a big mathematical proposition, as it takes so many figures that a person must be an expert and never make mistakes to know whether it is right or not after it is figured. But square out the same distance; measure over to the intersecting point or apex of the cone, and that

same measurement measured down the side of cone from intersecting point gives it. The dotted lines below show how to get ¼ of its contents.

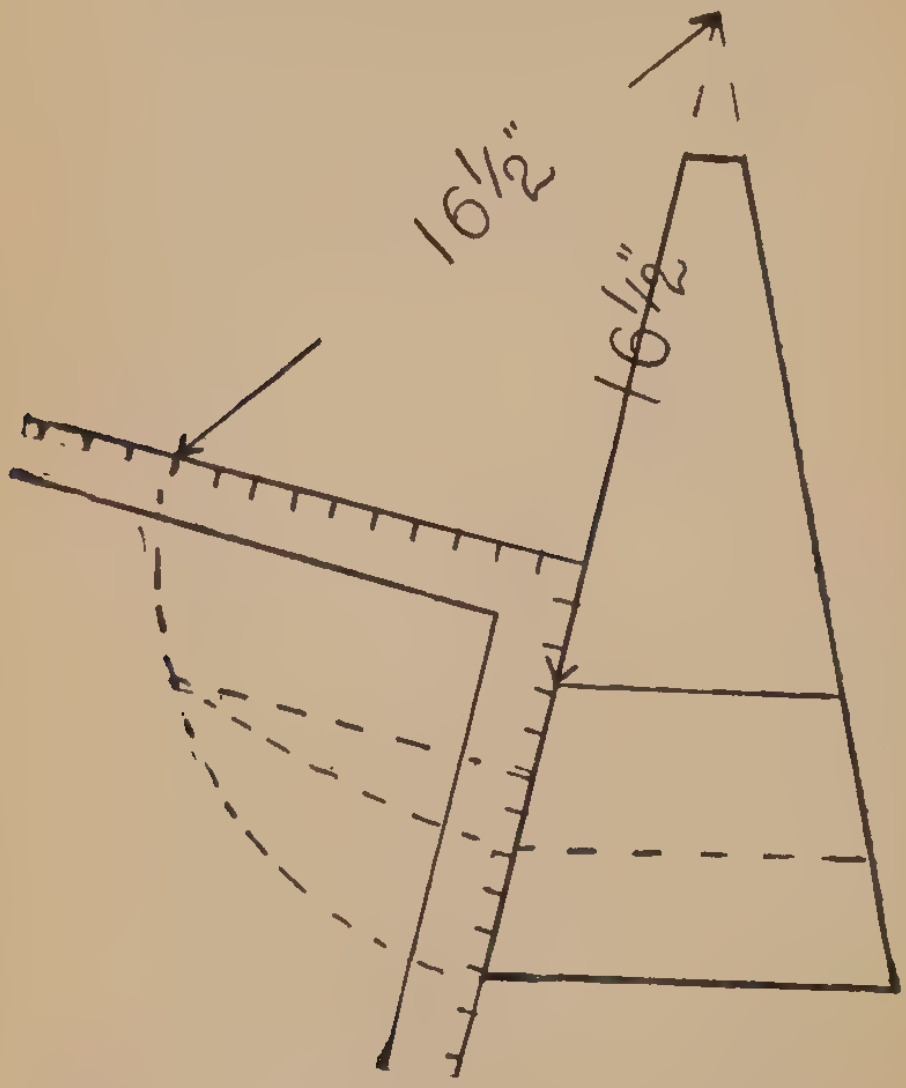


FIG. 113. FINDING HALF OF CONE.

Now this method can be applied to a square, octagon, circle, or any kind

of figure, even to a figure where the sides are of a different length.

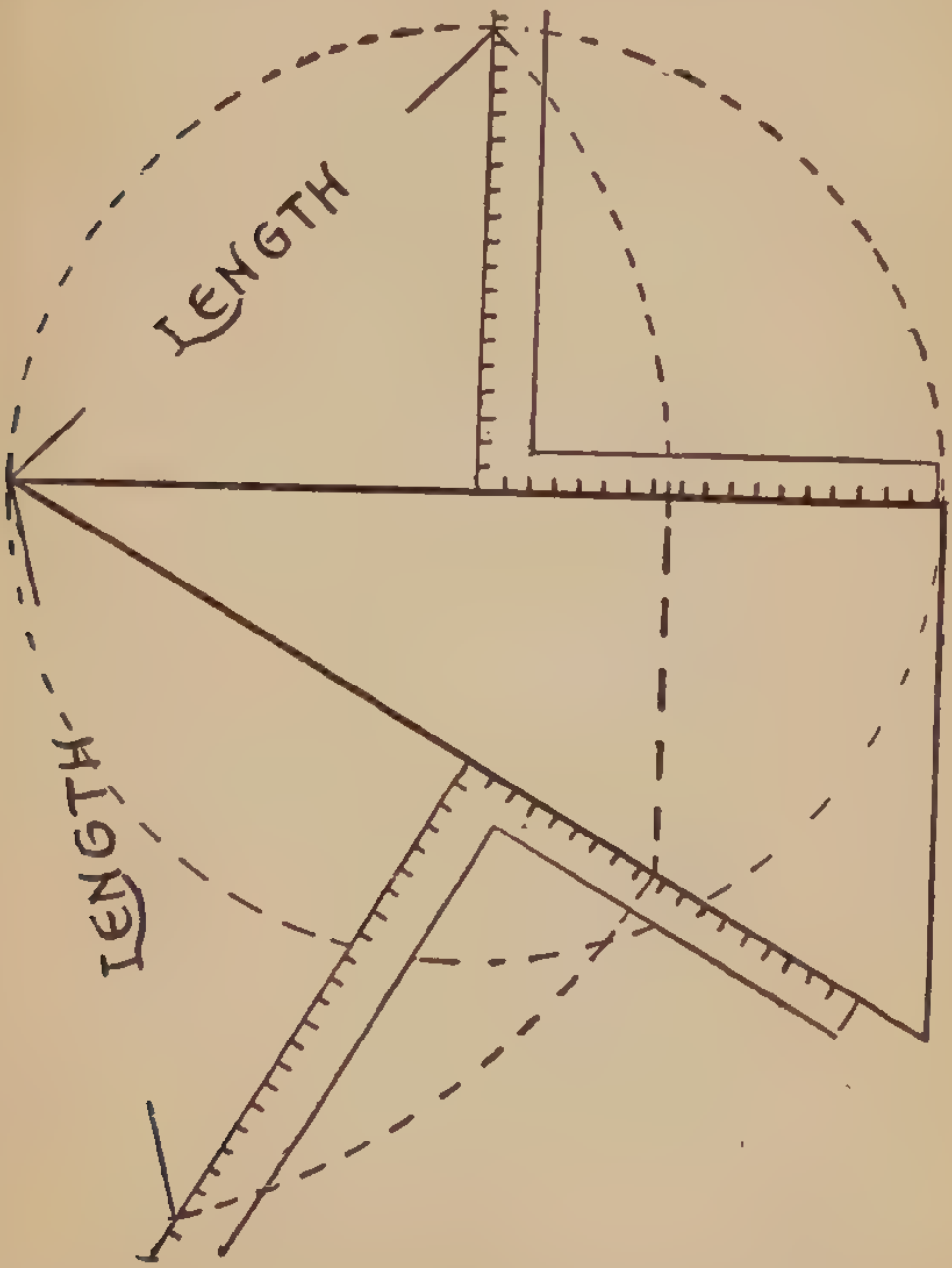


FIG. 114. SIDES OF DIFFERENT LENGTH.

Fig. 114. Is too plain to need any further explanation.

To reduce the length of an object and find out what the width will be is simply an example in proportion, and the square tells you instantly.

Fig. 115. To reduce anything from 13 inches long and 10 inches wide down to 7½ inches long. It is practically 5¾ inches.

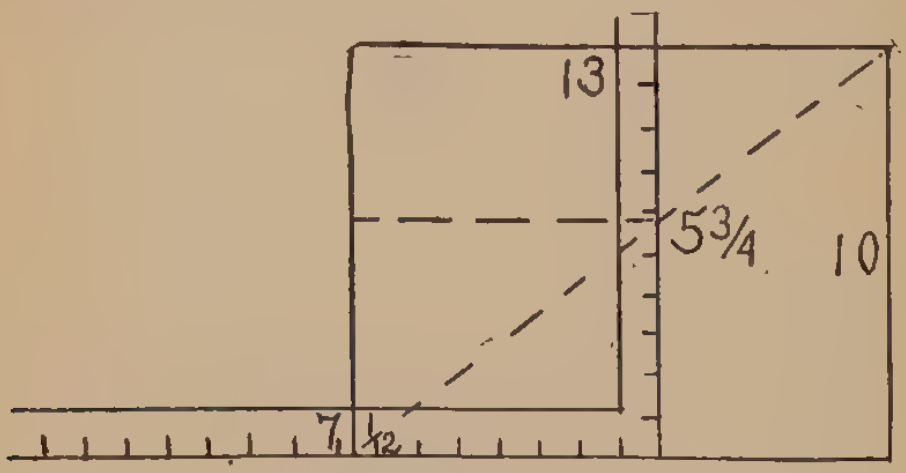


FIG. 115. REDUCING BY THE SQUARE.

Not only does the carpenter come in contact with these propositions daily, but many others as well. The photographer possibly meets this proposition more frequently than any other trade or calling.

In proportion we generally have

three numbers given and one to find. Place the square on two numbers, bring it down to the third and it gives the fourth.

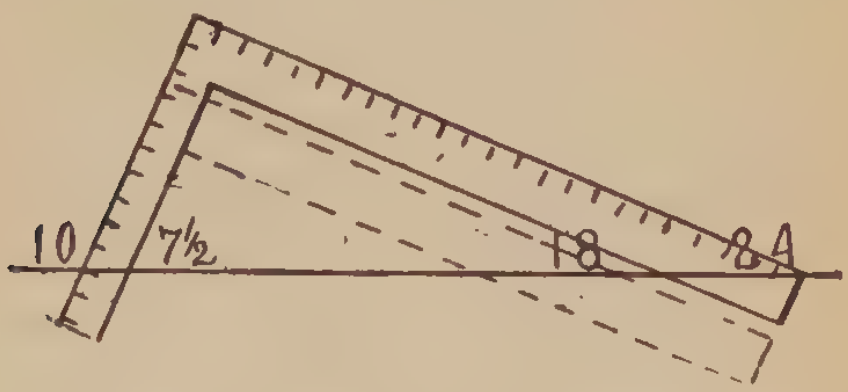


FIG. 116. EXAMPLE IN PROPORTION.

Fig. 116. If 1,000 feet of lumber cost $24.00, 750 feet cost $18.00, which is simply another example of proportion, and I think needs no further explanation.

Fig. 117. To find the number of courses of shingles for a roof: If they were 4 inches to the weather it would be three to the foot, and very easy; therefore to get any number practically as easy is the point. If 4½ inches, two courses would be 9 inches actual measurement; place one end of a rod

a foot long at 9, swing around until the other end of the foot strikes the square, which is at 7 15-16. If the roof is 18 feet, measure from 18 parallel with the line just made, and it

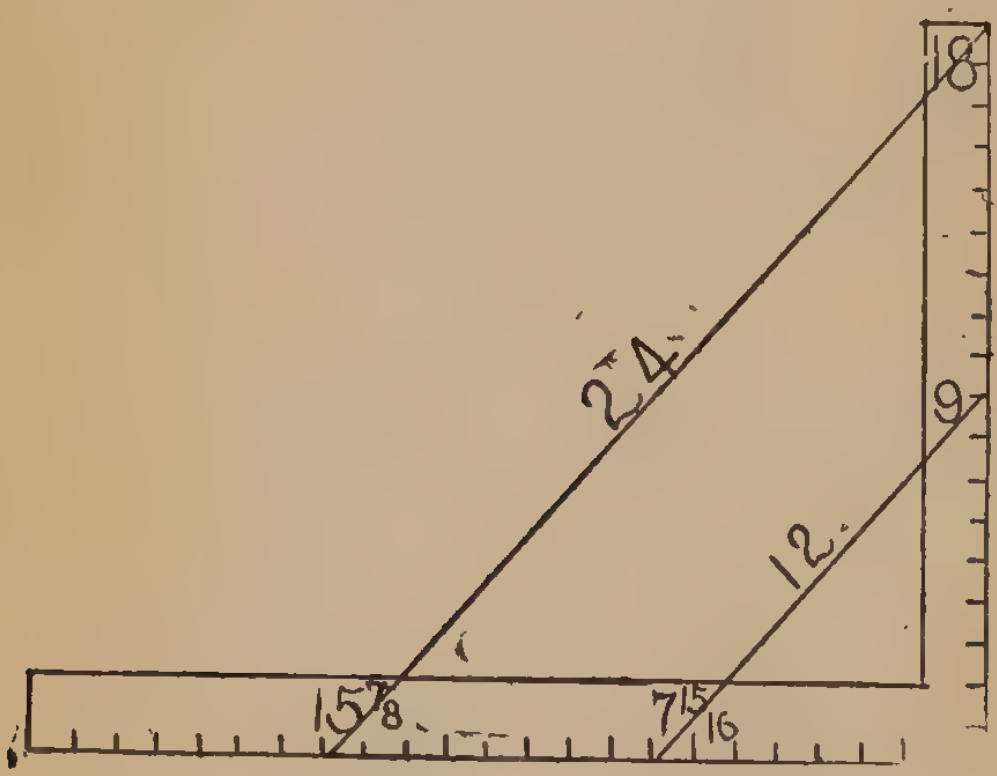


FIG. 117. SHINGLES FOR A ROOF.

strikes the square at 15⅞, and the line from 18 to 15⅞ is 24; two courses to every foot diagonal measurement gives 48 courses.

While the above methods are original with me the principles on which

they depend are old. Since the first edition of my book was published considerable interest has been shown in problems of this sort; in fact a book—as mentioned below—devoted entirely to the subject of calculating has since been published.

Any reader wishing to understand the principles on which these rules depend will find it simply and thoroughly explained in Albert Fair's book, "The Steel Square as a Calculating Machine," which is published at fifty cents by the Industrial Publication Co., New York.

Fig. 118. The height of a tree is indeed a hard thing to measure with a two-foot rule, but a two-foot square measures it easily. Measure off, say, 100 feet; place the square exactly plumb; sight across the square at 12; if the top of tree just catches the other 12 on square, then the tree is just 100 feet high; should it strike 18 on the square, then the tree would be (same

as the square) 1½ the level measurement, or 150 feet. For convenience the square should be placed on a stump or

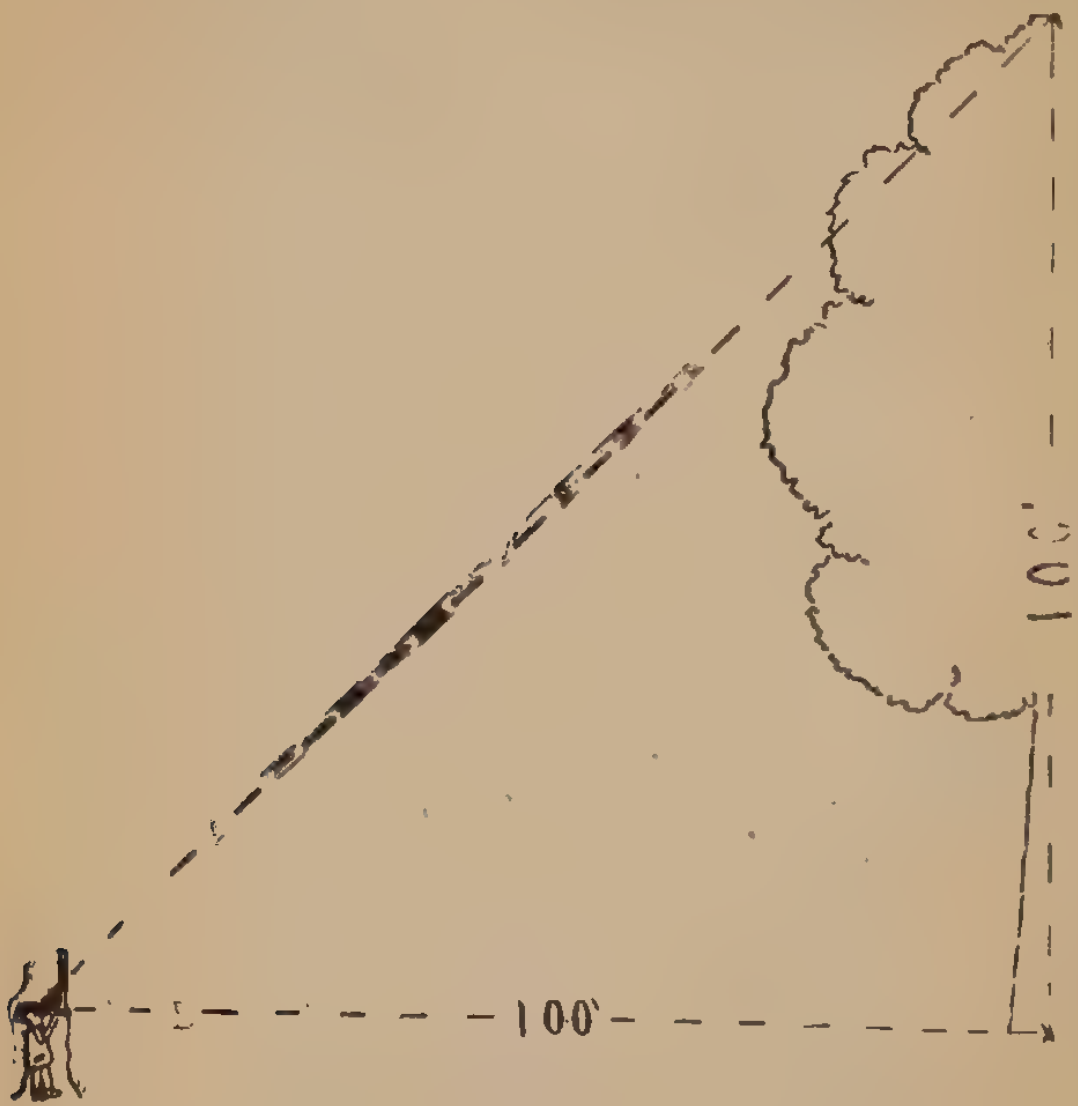


FIG. 118. FINDING HEIGHT OF TREE.

stake, and the height of this must be added to the height of the tree if above level.

Measuring a distance across a stream is the same method only the square is laid down level instead of plumb.

Fig. 119. To bend a board for a circle. If the given length is 2 feet, saw in and bend the board up until the

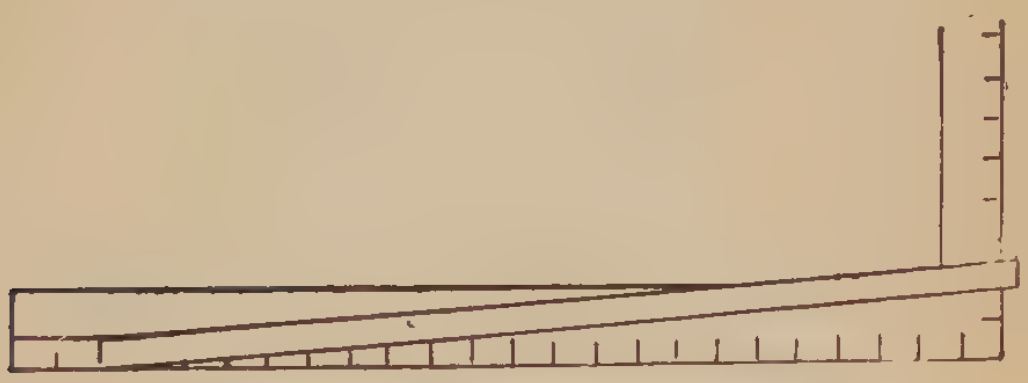


FIG. 119. SAW KERFING.

joint closes; if the saw cuts rather wide, it will raise at end about 2 inches; therefore saw in every 2 inches.

In previous pages I have illustrated how to frame a roof by taking the rise to the foot and applying it as many times as feet of run, which is a very good way for many ordinary roofs; how to take the rise and run, which gives length of rafter; also how a small

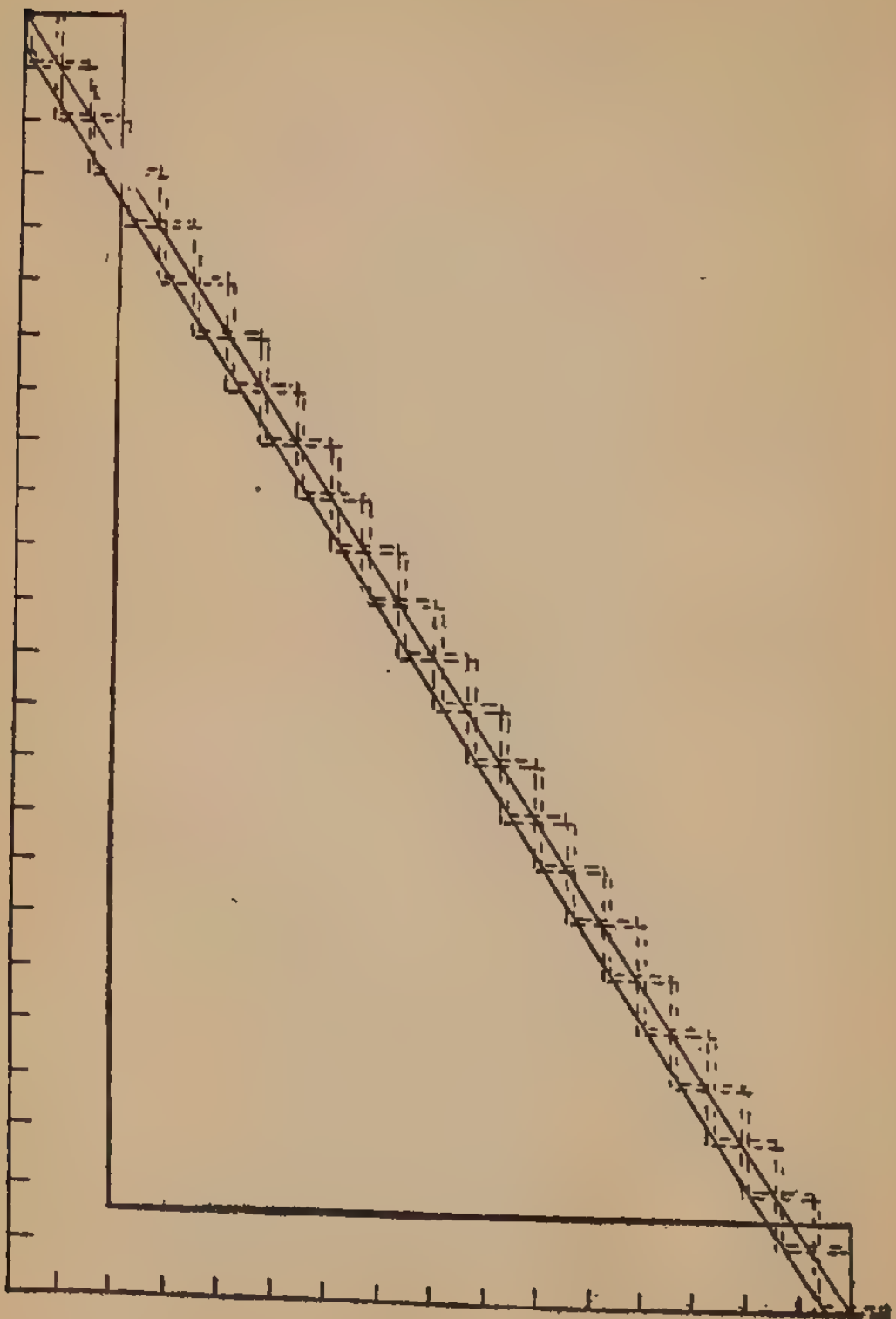


FIG. 120. LAYING OUT RAFTERS.

roof of two-foot run could be cut full size by laying the square on it full size.

Now if little roofs can be laid out full size direct with the square, if we only had a big square all roofs could be laid out direct from it.

Fig. 120. If we had a big square with a 24-foot blade (instead of twenty-four inches) and a 16-foot tongue, lay the rafter across its full length and it would give length and cuts of a three-quarter pitch roof for a 16-foot run or a one-third pitch roof for a 24-foot run.

And it would save much time of applying the square twenty-four times as little dotted squares show.

It is a difficult matter to apply the square accurately twenty-four times, and a person must be very careful to do it and not make a mistake somewhere, even in the count, if nowhere else.

But, as I have already mentioned, the ordinary square is the most unhandy tool the carpenter has to carry

in his condensed kit of to-day; of course this big square I mention would not be practical at all. Therefore, to substitute, we take the common square and take the feet the building is and use it as inches on the square and one-twelfth on the square for one inch of actual measurement.

Measure across the square and the number of inches and one-twelfth it is on the square the rafter should be that many feet and inches.

This method for large roofs and many others is much better than the other. Simply take rise and run measure across the square and that is length of rafter.

Supposing we were cutting a big roof for all the main part of a house of nine inches rise to the foot.

And we cut it by the first method and had to assist us a square with the explanation on it how to do it, and, besides, we had other rules, tables, keys, etc., at our command.

Then the rear part of the building was one story and the pitch was wanted just as great as possible under main cornice. If the back part was 13 feet 6 inches and our height 9 feet 8¾ inches I am afraid with all our keys, charts, tables and rules, as simple as it is and as common, too, most carpenters would have to do just a little figuring.

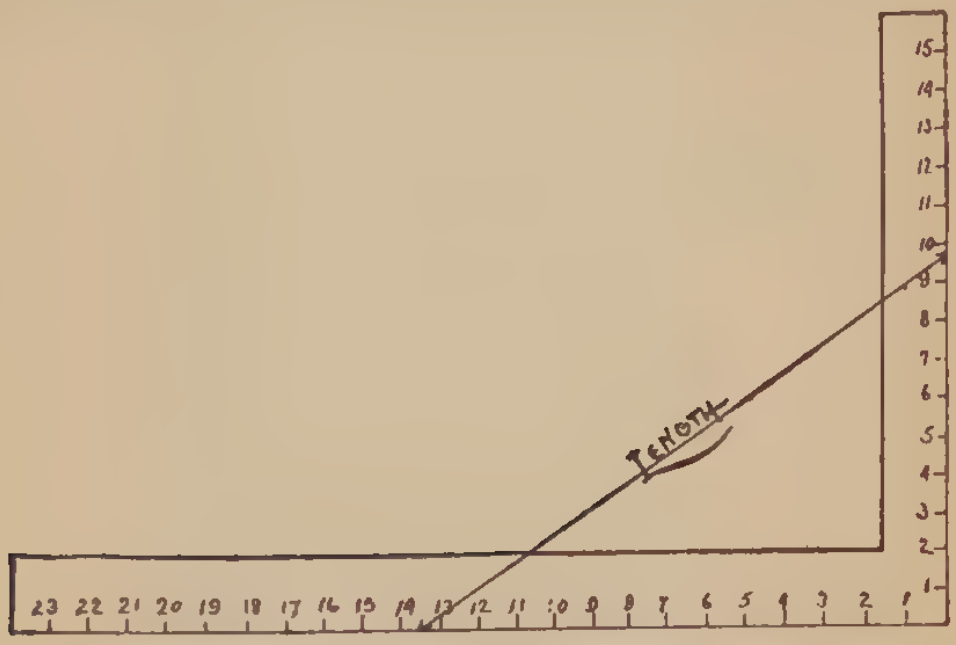


FIG. 121. LENGTH OF RAFTER.

Fig. 121. Shows it instantly. Measure across your square at rise and run and that measurement is length of common rafter.

Fig. 122. Shows that to measure across the diagonal of the width of the building gives run of hip.

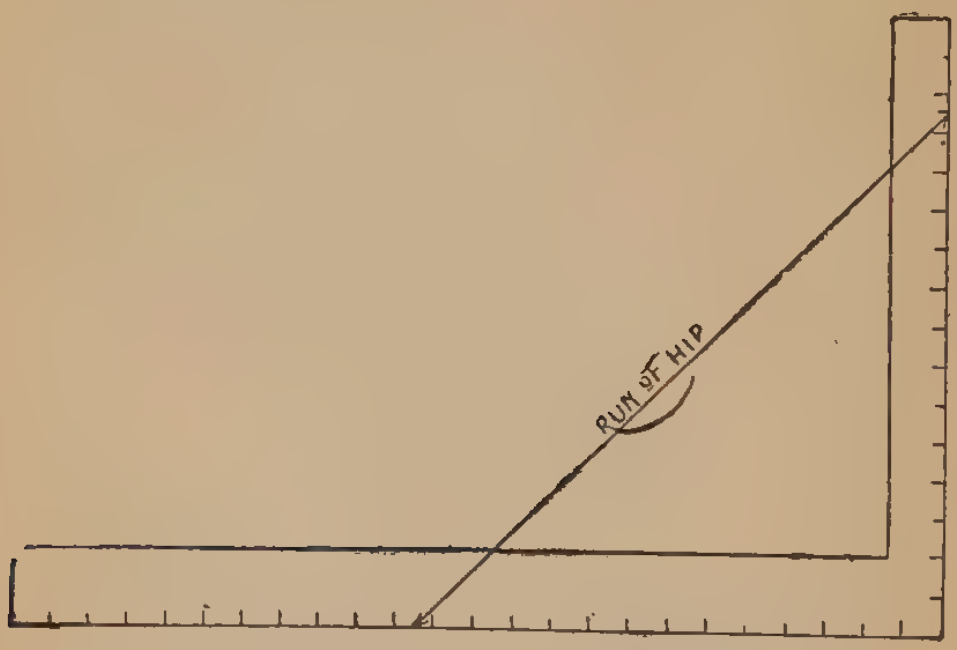


FIG. 122. RUN OF HIP MEASUREMENT.

Fig. 123. Illustrates that this run and rise gives length of hip.

The jacks can be easily figured and a good way is to lay them off on a common rafter and use it for a pattern to get length of all jacks. But if you wish to get the length of jacks direct with the square it is very simple and fully explained in other parts of this book.

Fig. 124. Illustrates an octagon figure, and it matters not whether it is a part of a figure as a bay window, or

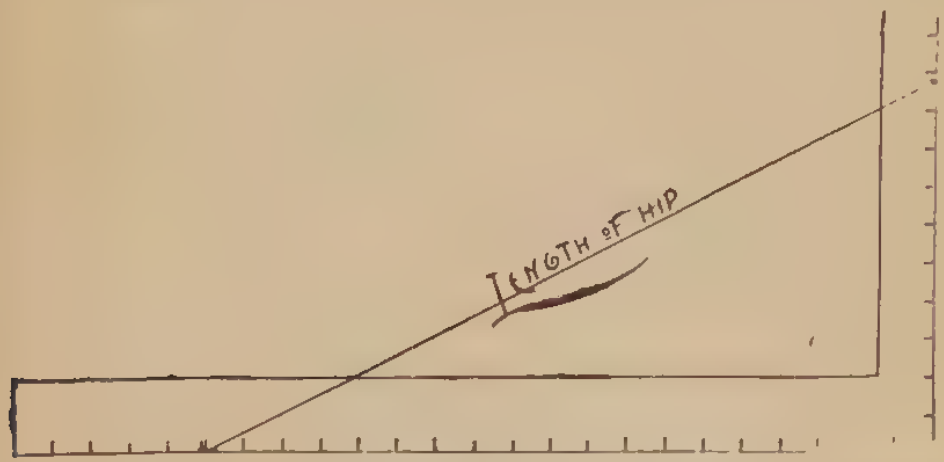


FIG. 123. MEASUREMENT OF HIP RAFTER.

more of a figure as a tower, or a complete octagon building the length of

FIG. 124. SIDE OF OCTAGON.

one of the sides would be the same and there are many ways to get it.

Fig. 125. Shows the simplest way I know which is to simply measure

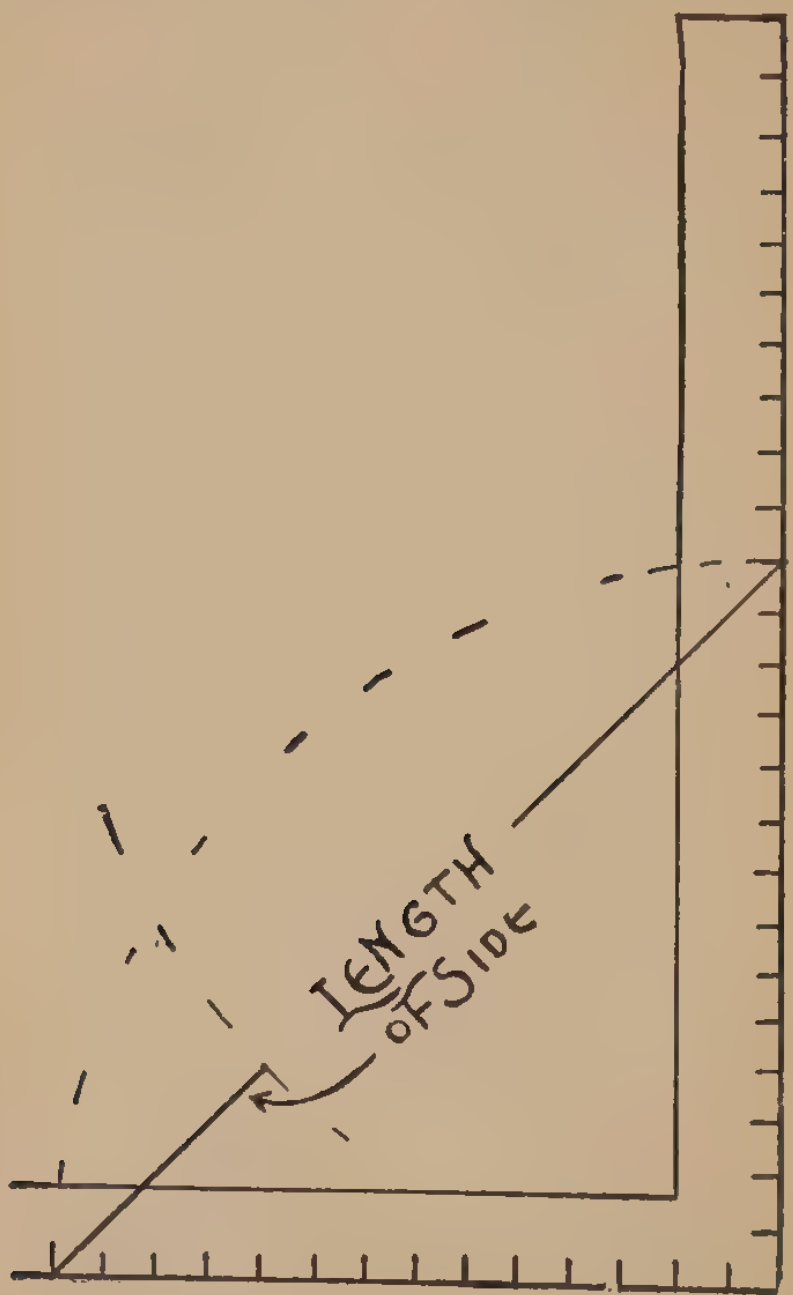


FIG. 125. MANNER OF FINDING LENGTH.

across the diagonal of the diameter of the octagon, and subtract the diameter

from the diagonal, and it gives the length of one of the sides.

Fig. 126. It often comes very handy to use the degrees using 12 on tongue: I have given at the right the figures

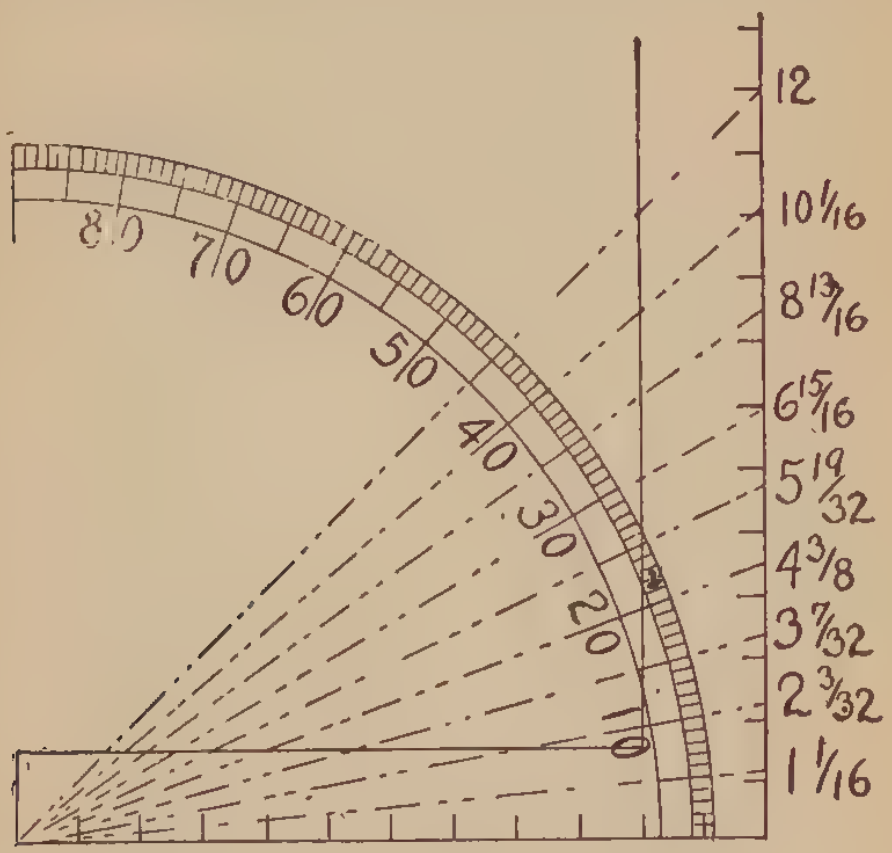


FIG. 126. DEGREES.

to use on the blade at every 5 degrees up to 45, reverse them to complete the circle.

Fig. 127. Of all the diagonal measurements across the square there are

only a few that are exactly even, in fact the three illustrated are the only

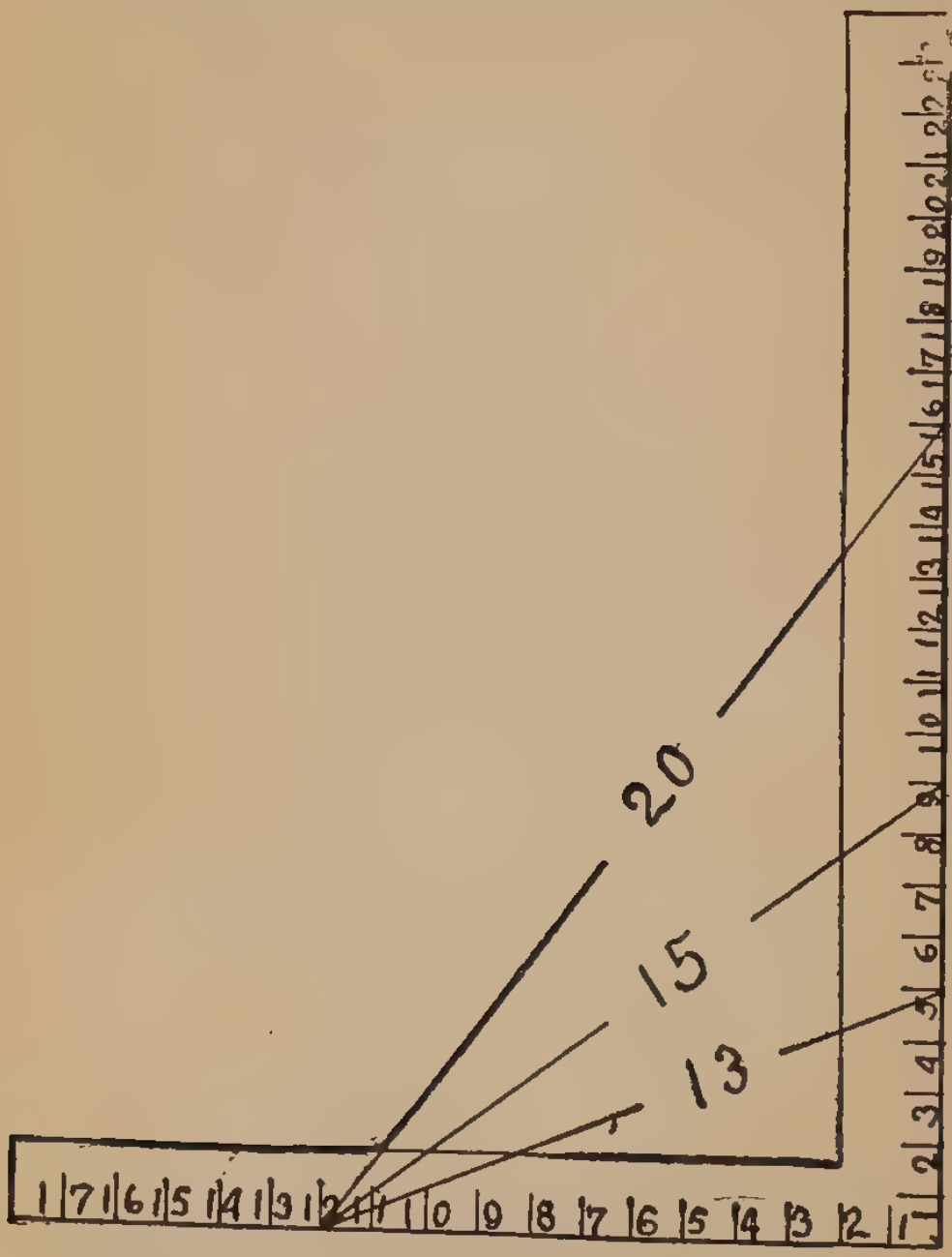


FIG. 127. EVEN MEASUREMENTS.

ones that come in constant use 5-12 are 13, and as 5-12 is practically an octa-

gon this is used very much in octagon work, of course it is handy often to double this and use it as 10-24—26.

9-12 are 15 and a roof with 9-inch rise to the foot makes a nice pitch and every foot of run is just 15 inches of rafter, of course on a large square this can be doubled and used as 18-24—30.

12-12 is very often used as 17, though it is not quite exact. 12-16 are 20 and makes a nice pitch where one is wanted that is over ½ pitch as each foot of run is 20 inch of rafter. One-half of this or 6-8—10 is the measurement so much used in squaring a building, of course again ½ of that can be used, thus 3-4—5.

A knowledge of these little facts comes very handy in a carpenter's daily work.

Fig. 128. Circles, ellipses and ovals can all be laid out nicely with square, a stick with two nails in it, and a pencil. Should the square be held still and go clear around with the stick with two

nails in it and pencil, one corner would be the big circle, another the small circle, and two elliptical, one each way; therefore to make a complete design the square must be reversed.

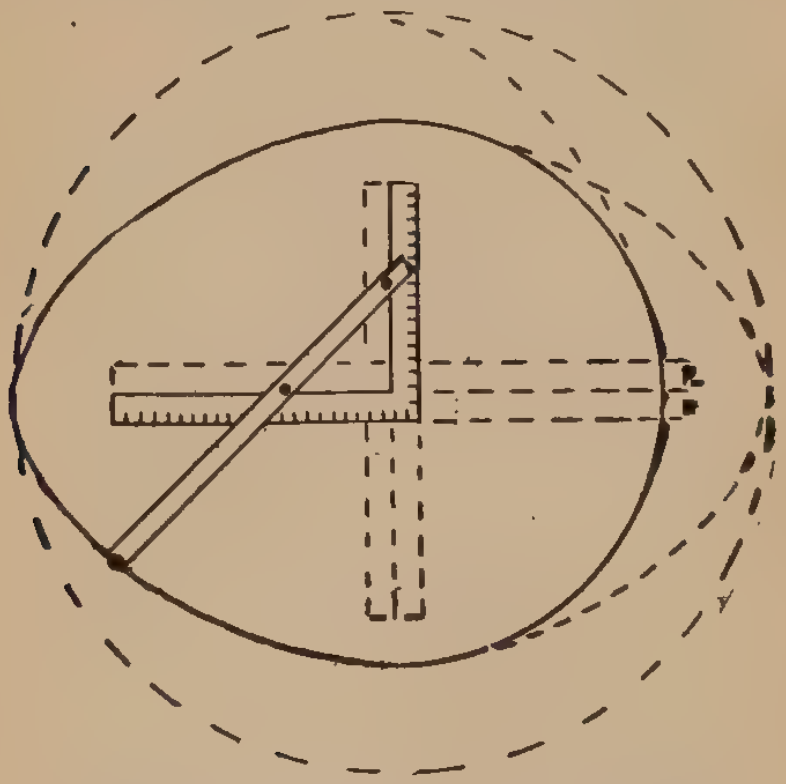


FIG. 128. CIRCLES AND ELLIPSES.

If the illustration is not all plain enough to be grasped at a glance, a little practice will make it plain, I am sure.

Fig. 129. Bicycle races used to be all the go; although they may soon be

forgotten, there were some principles I learned building bicycle tracks that should always be remembered.

The upper left-hand corner shows the rafters in their right position, and

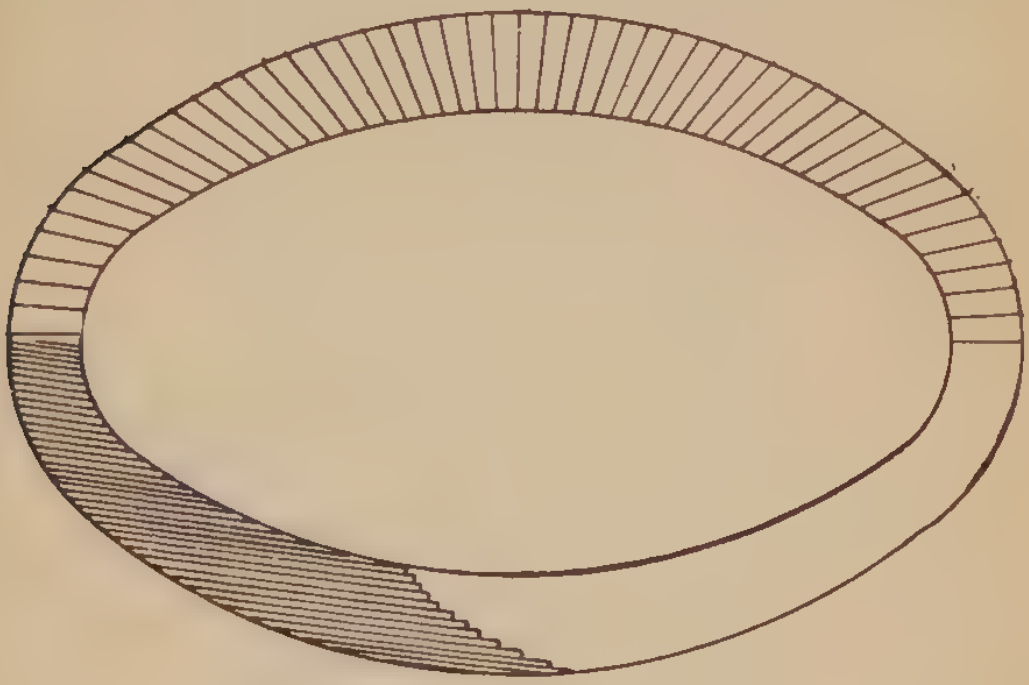


FIG. 129. BICYCLE TRACK.

in a general way toward the center, but not toward the exact center, as shown at the right.

The lower left-hand corner shows the manner of flooring. These tracks used to be built in halls about 50 feet by 100 feet in a day's time, and lady bicycle riders would dash around them

for hours and make over twenty miles every hour, and a great deal faster at the finish.

Fig. 130. The sides would raise less than ¼ pitch, or about 5 feet, and the tracks were generally made with a 12-foot rafter, rafters all the same length.

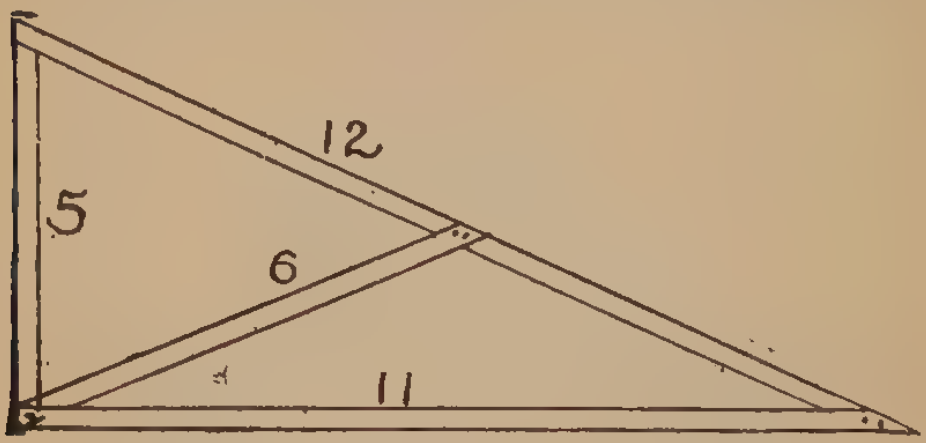


FIG. 130. SIDE RAFTERS OF BICYCLE TRACK.

Fig. 131. The ends would stand up at a little more than ½ pitch, or about 9 feet, and gradually grow lower until they got down to the height at side.

Fig. 132. As the length of rafter is given, get the height and find run. If the rafter is 12 feet and rise 5 feet, measure 12 inches across the square at 5 and it strikes the square at nearly 11

inches (near enough for this class of work); we therefore find, as 12 feet is length of rafter and 5 feet the height (or rise), the run would be 11 feet.

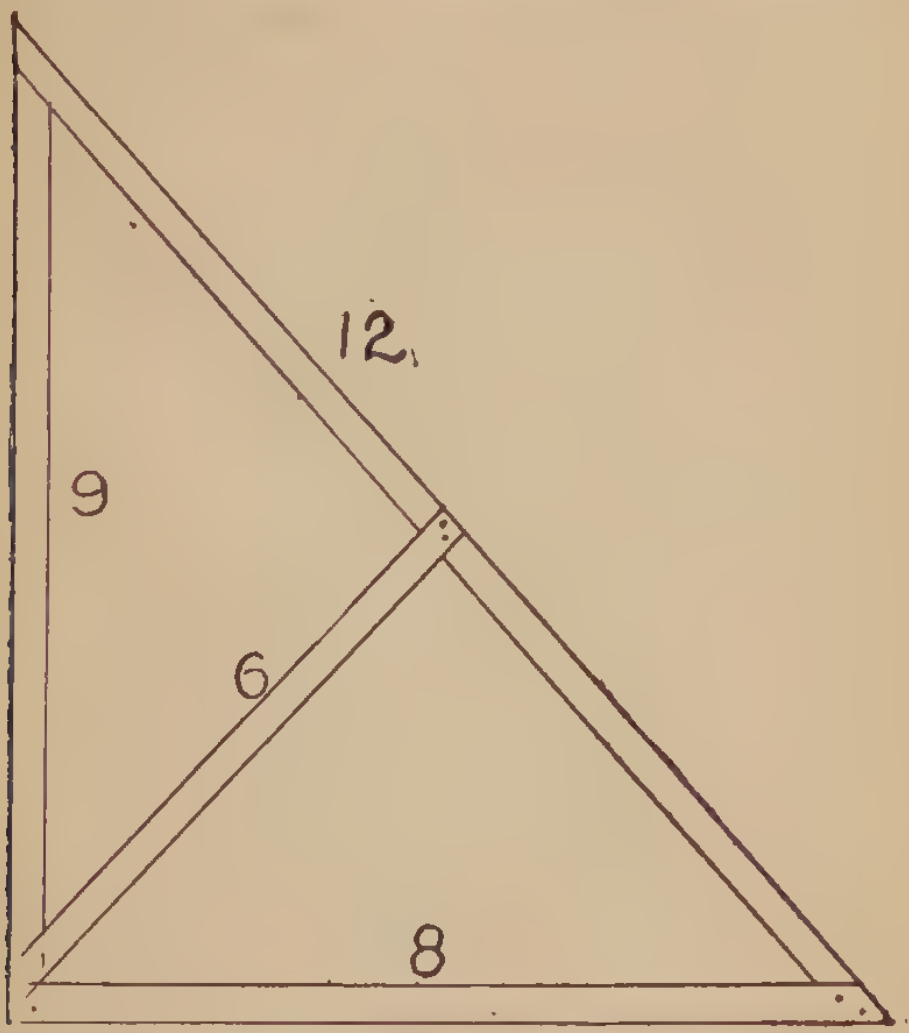


FIG. 131. END RAFTERS OF BICYCLE TRACK.

Fig. 133. Rise and run, cut on run, gives the bottom cuts.

Fig. 134. Rise and run, cut on rise, gives the top cuts.

Fig. 135. The top cut of brace can be found by putting the square on rise

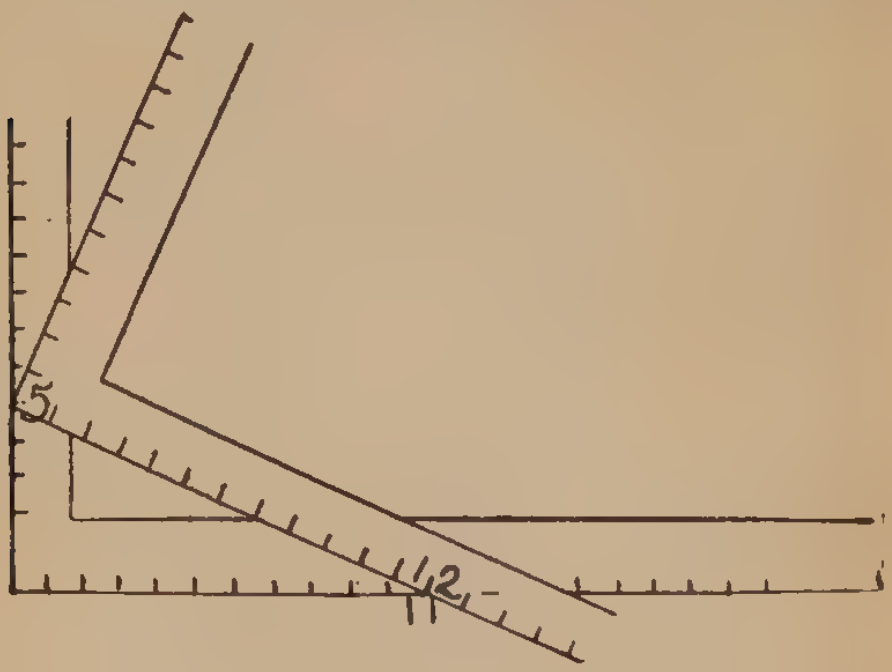


FIG. 132. RUN OF RAFTERS.

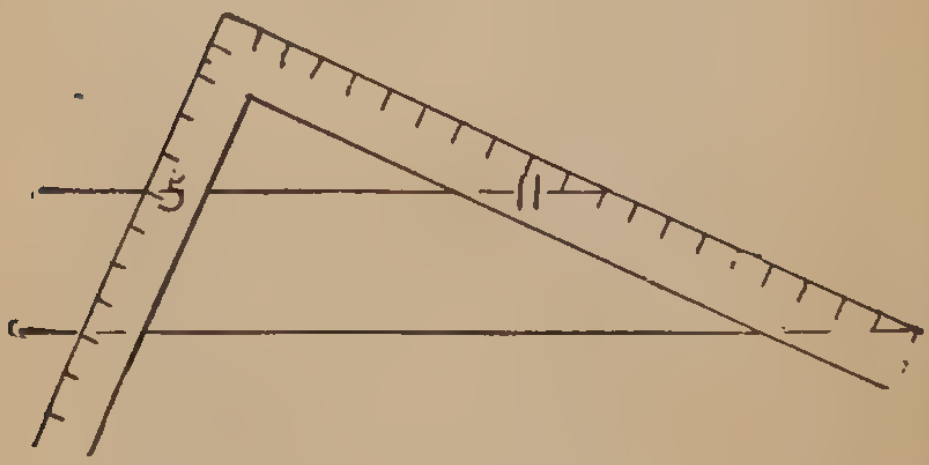


FIG. 133. BOTTOM CUT OF RAFTERS.

and run and using the run for a level line, and from that line lay off pitch of the rafter.

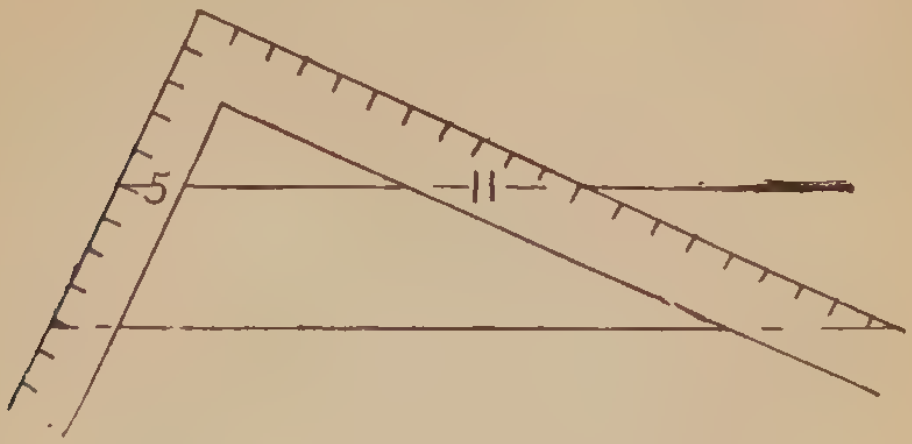


FIG. 134. TOP CUT OF RAFTERS.

Fig. 136. Should there be an elliptical arch 2 feet high and 7 feet wide, and to be centered properly for brick

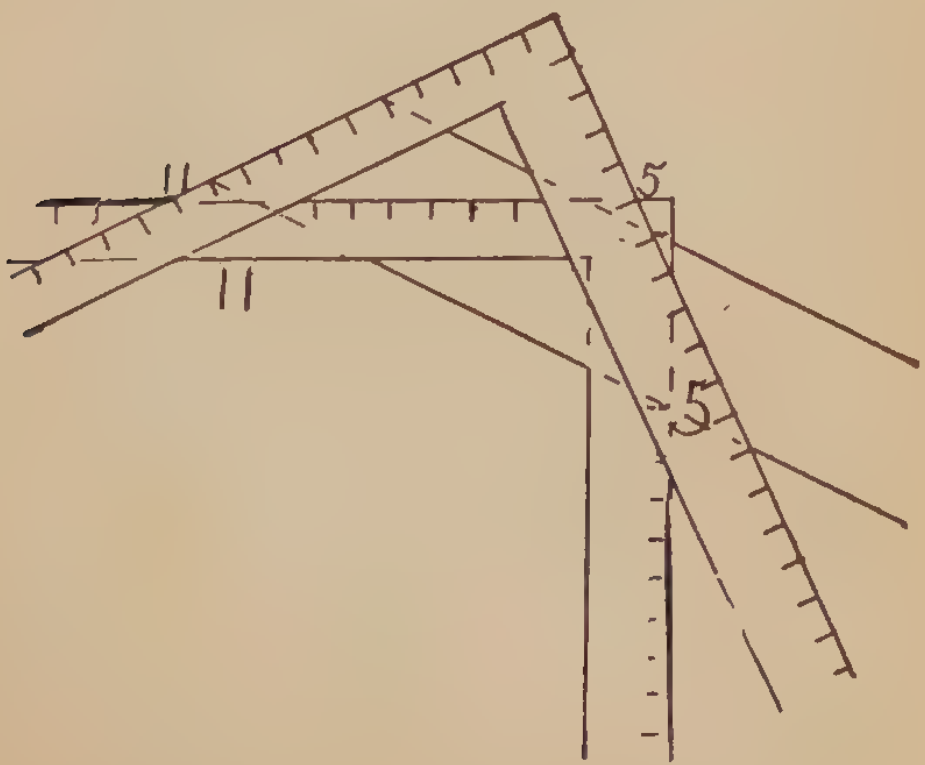


FIG. 135. TOP CUT OF BRACE.

work, stone or anything else, it would be necessary to get different centers; half as many places for centers below will do very nicely, but to be absolutely accurate it should be divided into just as many spaces below as above.

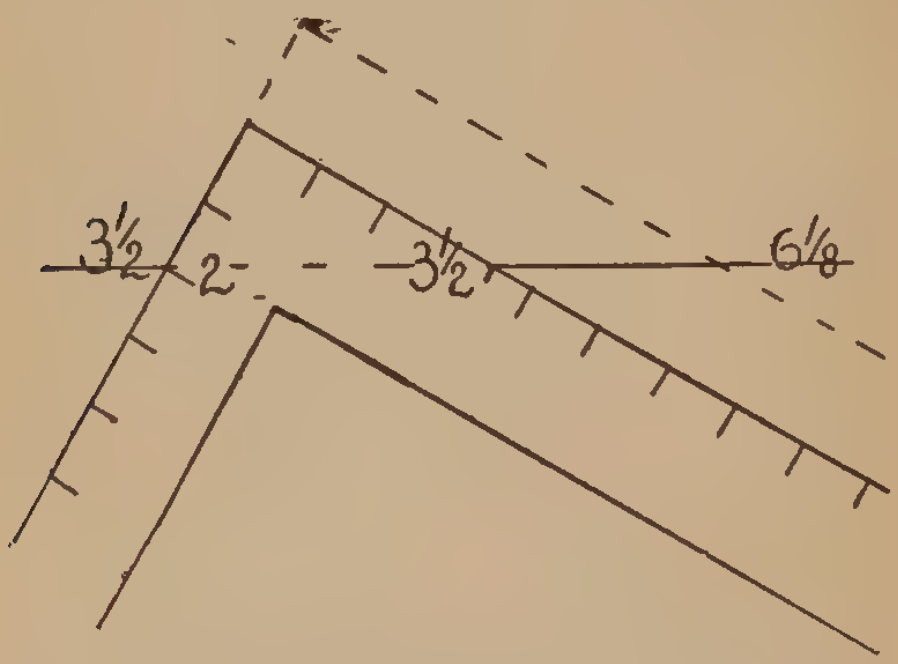


FIG. 136. MEASUREMENT FOR ELLIPSE.

And an ellipse below to correspond with the one above gives points to center, too. If the arch is 2 feet high and 3½ feet to center, as 2 inches is to 3½ inches so is 3½ inches to 6⅛ inches.

Fig. 137. Make the ellipse below to

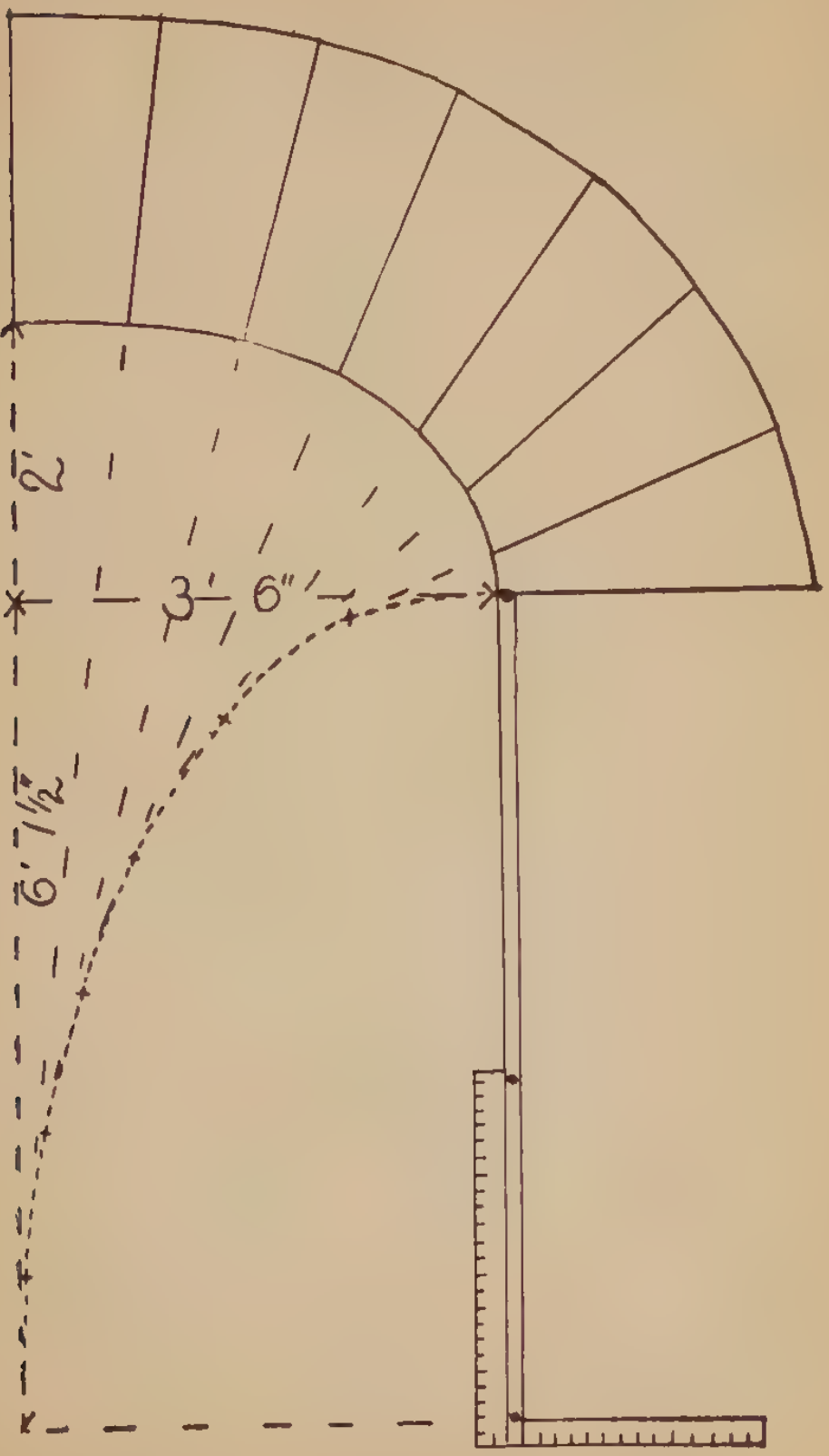


FIG. 137. CENTERING AN ELLIPSE.

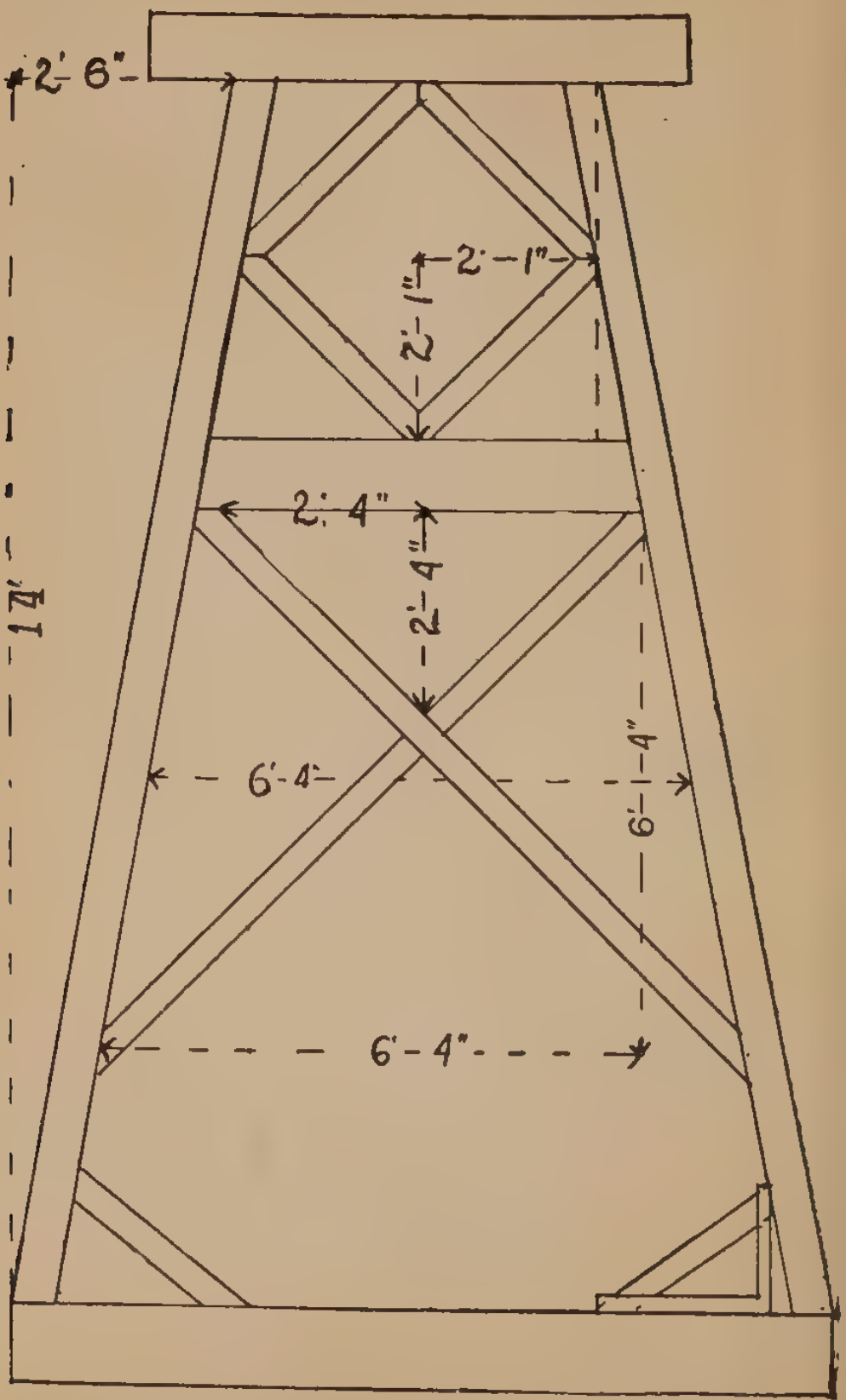


FIG. 138. TOWER FOR WATER TANK.

correspond with the one above; lay off the top of the arch into the desired number of spaces, and the ellipse below in the same number, and use these points to lay off the arch. I think the illustration too plain to need further explanation.

Fig. 138. A tower for water tank or other similar purpose made out of rough lumber may seem a very small mechanical job, and it is; yet if enclosed with boards there is practically all the principles of hip roofs and hoppers combined, and the putting in of the braces besides, which is no small job of itself, unless thoroughly understood. For further information refer back to this occasionally.

Fig. 139. As the post inclines 2 feet 6 inches each way, the measurement from the corner in, or the run of, the post, which is practically a hip, would be the diagonal of 2½ or 3 feet 6 7-16 inches.

Fig. 140. As the rise is 14 feet and

run 3 feet 6 7-16 inches, the length of post would be the diagonal of same, which is 14 feet 5¼ inches.

Fig. 141. As the post leans both ways, the ends have to be cut, beveling both ways.

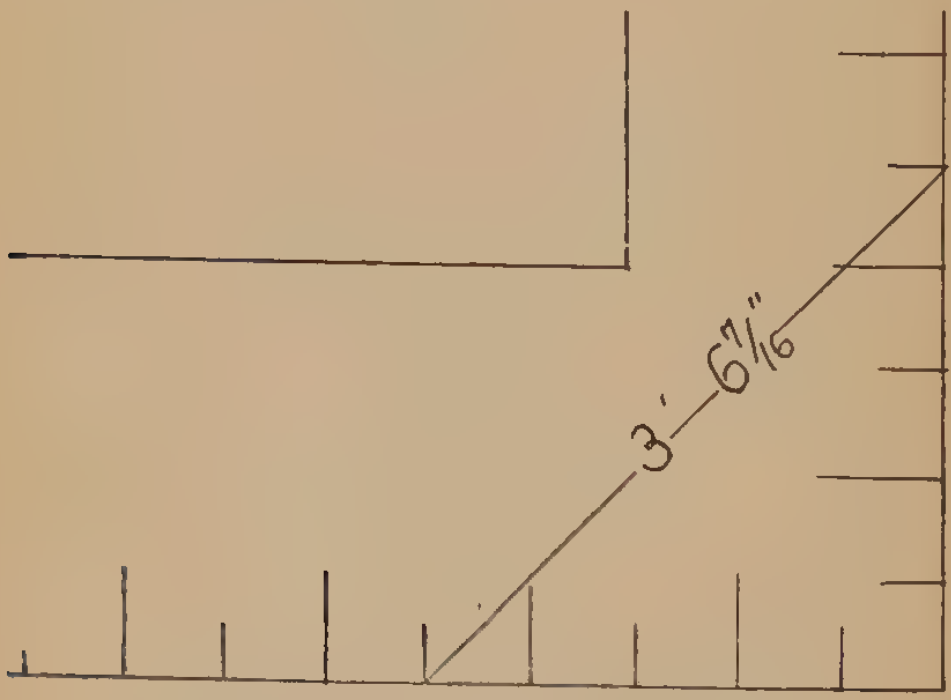


FIG. 139. RUN OF POST.

Fig. 142. While it is seldom that the post ever has to be backed, and if it only leans slightly there would practically be no backing, should there ever be an occasion to back the post, simply place the square on the end after it has

been cut off and it gives the amount to be backed; this applies to the b..cking of rafters as well.

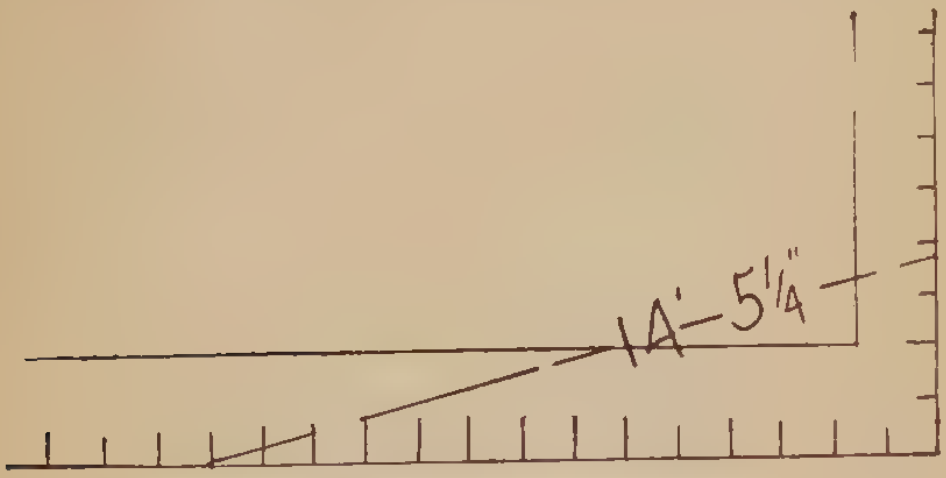


FIG. 140. LENGTH OF POST.

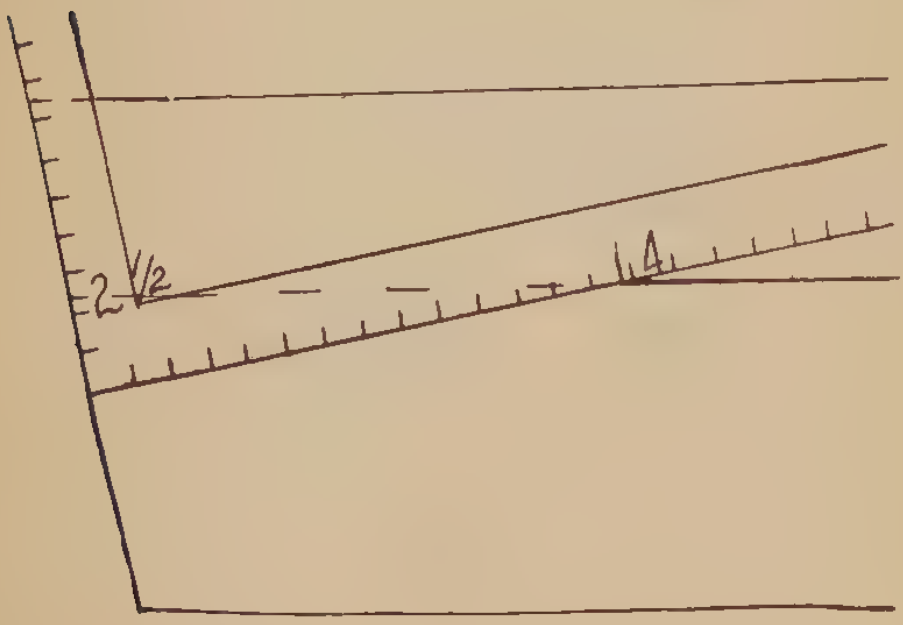


FIG. 141. CUT OF POST.

Fig. 143. For brace at bottom, with a 2-foot run and 18-inch rise, place

the square on full length and it gives length of brace and bottom cut and plumb cut at top; lay off from plumb

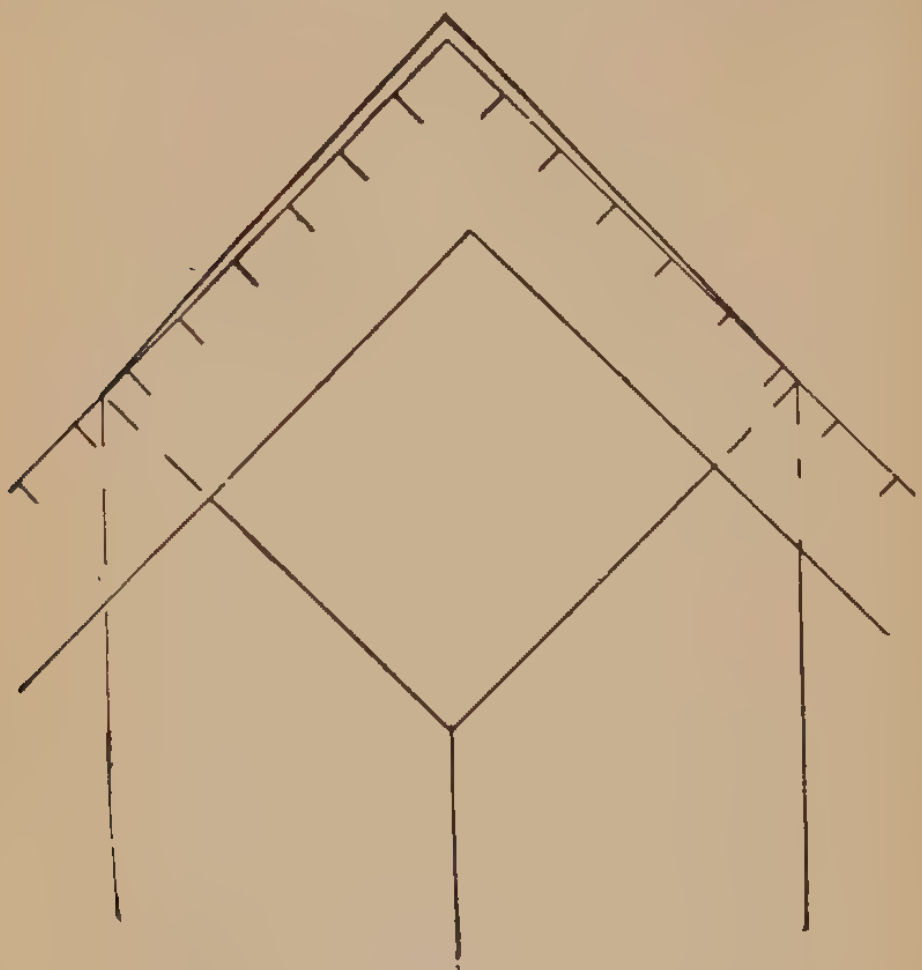


FIG. 142. BACKING OF POST.

cut the pitch of the post and it gives the top cut to fit against post.

Fig. 144. Take one-half height of main braces that measurement between the posts gives the rise, and if they are

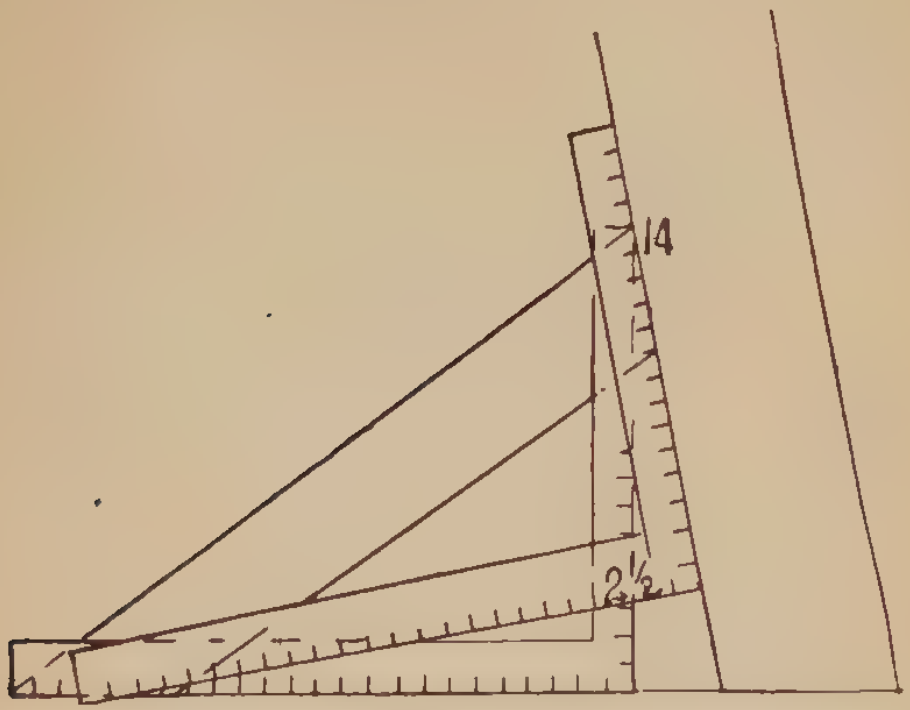


FIG. 143. LENGTH AND CUT OF BRACE AT BOTTOM.

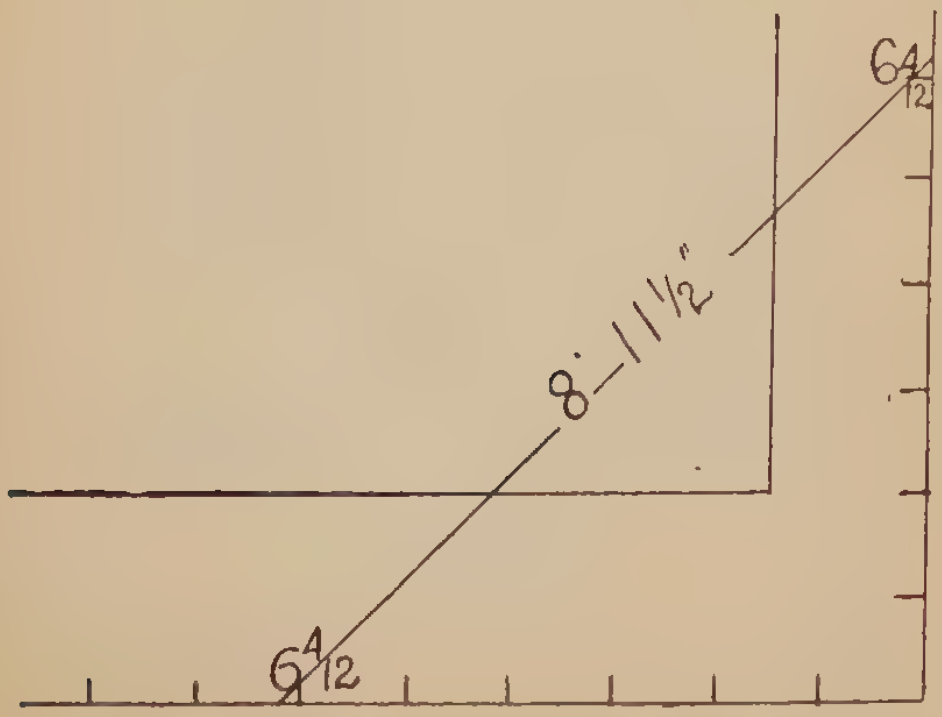


FIG. 144. LENGTH OF LONG BRACE.

at an angle of 45 degrees it gives run also, which in this instance is 6 feet 4 inches, or plumb down from top of brace and measure over to the bottom and it also gives the rise and run.

All these measurements can be made direct from the square or squares—one

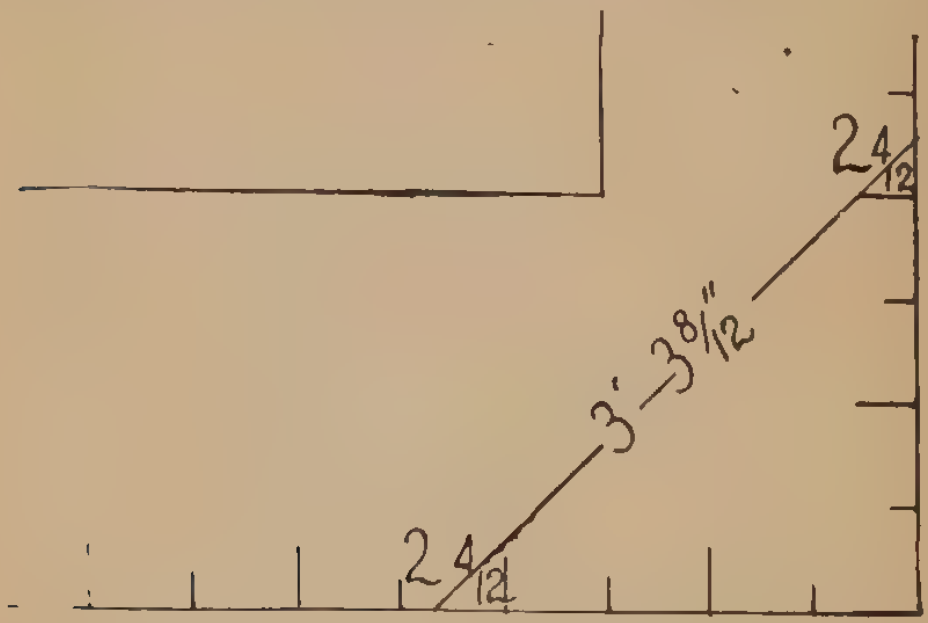


FIG. 145. LENGTH OF HALVING BRACE.

laid down square and the other thrown around the pitch of post.

The diagonal of 6 feet 4 inches is 8 feet 11½ inches, length of brace; the end cuts are cut on same principle as bottom brace against post just described.

Fig. 145. Should the braces be halved, the distance from the shoulder to the center, which is 2 feet 4 inches, gives the run; measure across diagonally and it gives 3 feet 3 8-12 inches; length to upper part of half the width of brace gives the lower, and there you have it ready to halve.

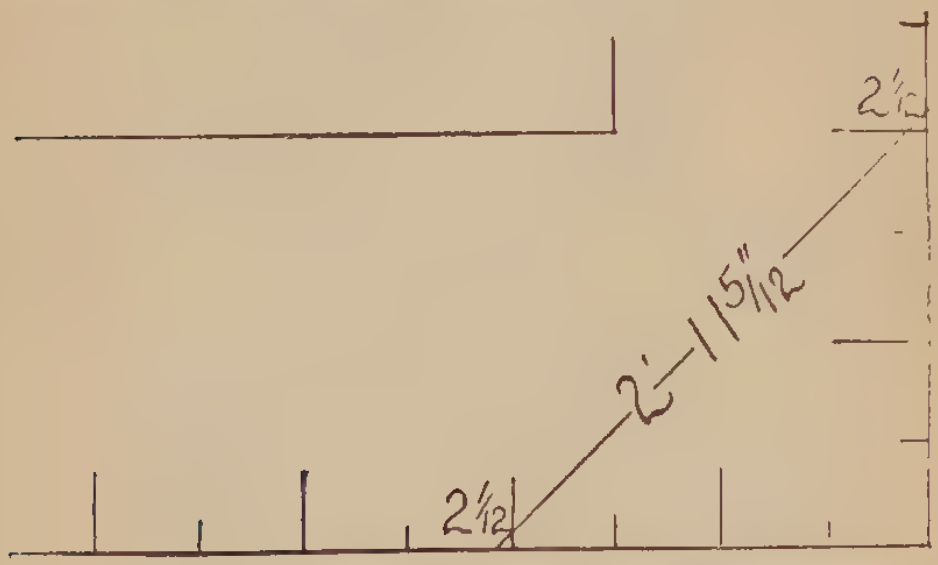


FIG. 146. LENGTH OF TOP BRACE.

Fig. 146. As the rise and run of the upper braces is 2 feet 1 inch, the length of braces is diagonal of same, or 2 feet 11 5-12 inches; the cuts are all square miter, except at sides against posts, which are cut pitch of post.

Fig. 147. The girder between the

braces is of course simply cut at the ends the pitch of posts, but as the post inclines both ways, the outer corner is a little prominent, and to be exactly right should be backed as described before; therefore the inside would be just that much scant, or, in other words, the inner side of girder to fit the posts

FIG. 147. SIDE CUTS OF GIRDER.

should be just as much longer as the backing of the post, or the length and rise of post added together and the run cut on run. As these measurements in feet are too long for the square, reduce to inches; I reduced them to ½ inch measurements in my illustration.

Fig. 148. Braces at a level at bottom to fit an inclined platform or roof

at top are cut on about the same principle as tower braces.

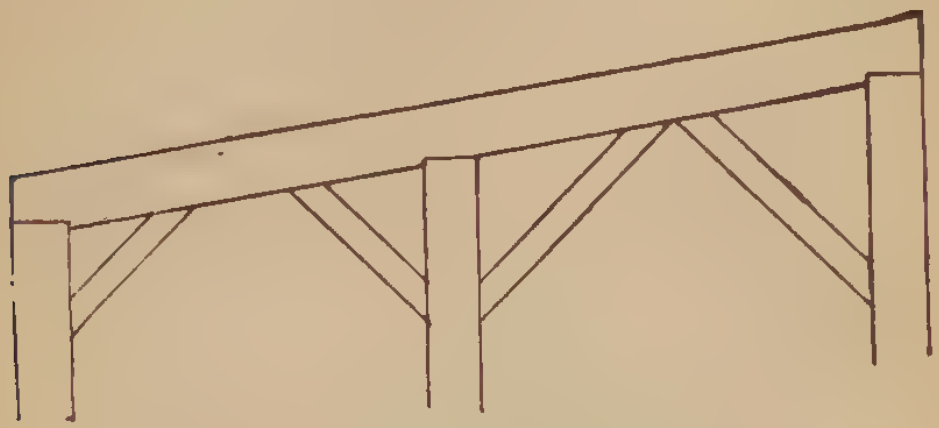


FIG. 148. BRACES FOR SHED.

Fig. 149. The squares at the left show the manner of applying to cut the

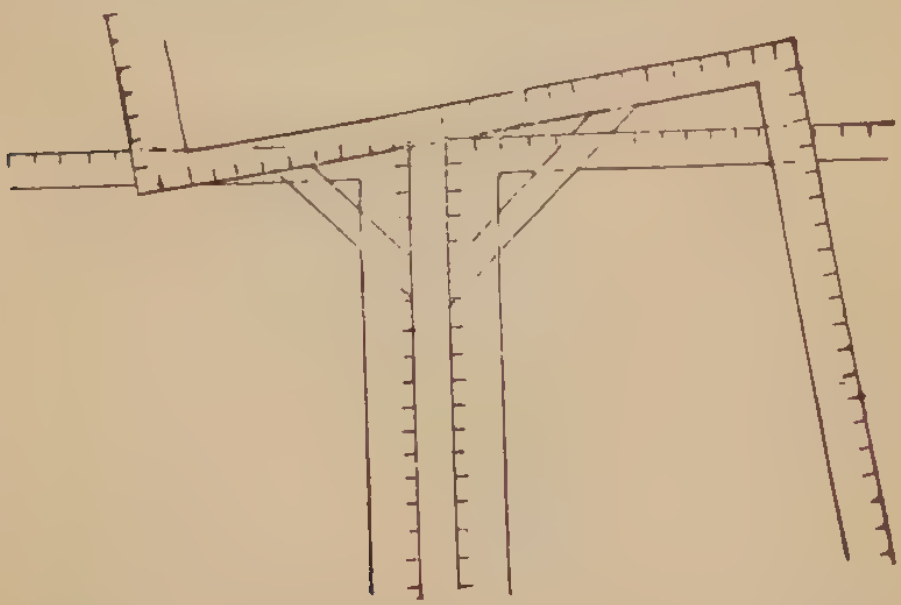


FIG. 149. LENGTH AND CUTS OF BRACES.

lower brace on the center post; from top of post to bottom of brace gives

run; if at an angle of 45 degrees, as shown in illustration, the rise is the same.

Note the notch in rafter at top of post and allow for same.

The squares at the right show how to get length and cuts of upper brace at center post.

I think the illustrations are too plain to need further explanation.

Fig. 150. I give this as a Star of Hope that every reader of this little book will become a master of the square and with it be able to measure out his full share of this world's goods and make life really worth living.

I also trust and hope that this Star and the other illustrations will throw enough light on the subject, that all will feel well paid for their investment.

By referring back to polygons you will see that a five-sided figure is laid out by using 8¾ and 12, though I mentioned these figures are not exactly accurate in this the 8¾ is the least bit

strong. It is surprising how many different ways these measurements can be applied on this Star, and there is absolutely no end to this kind of applica-

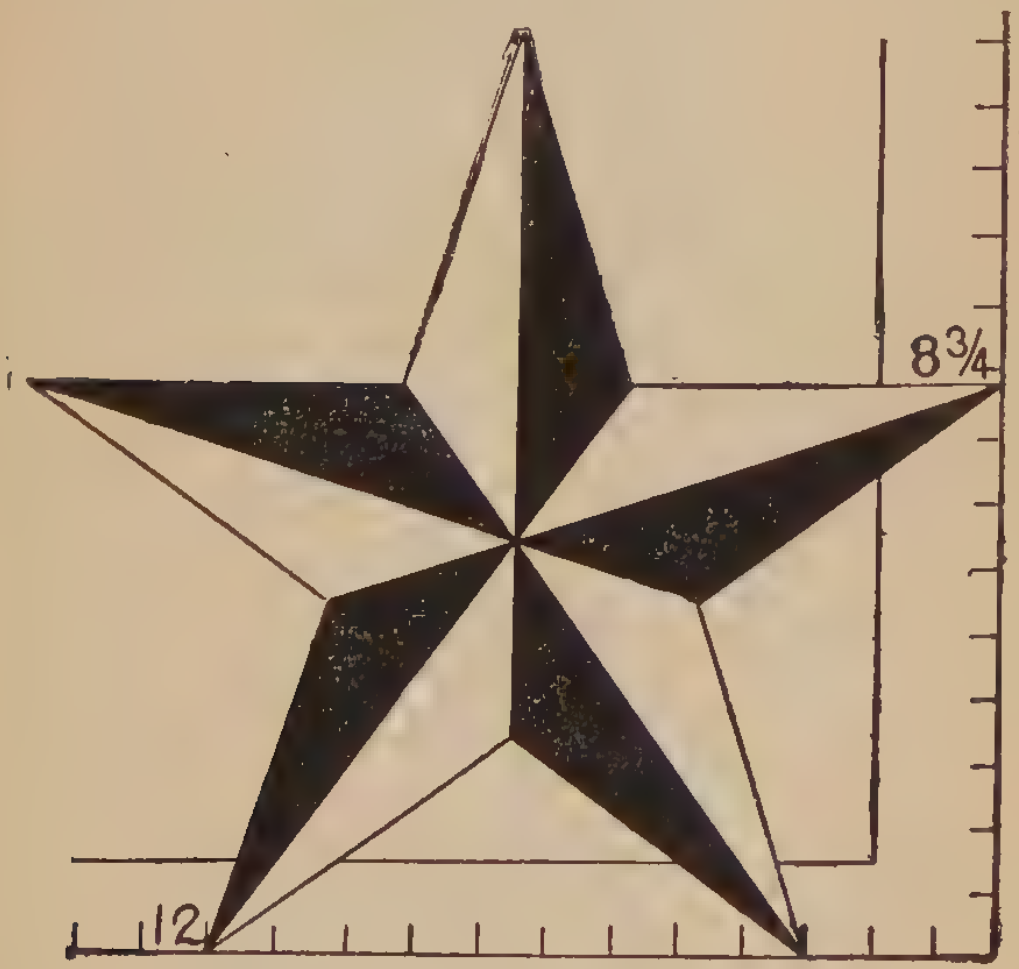


FIG. 150. LAYING OUT STAR.

tions, but I trust it is not necessary for me to take the matter up further as I think I have given enough to show the principle, and therefore the reader will

be able to apply these principles so as to work out any practical problem that may arise in the every-day work of the carpenter.

Much more could be said, but I hope enough has been given here to give the beginner a very good idea of the practical uses of the steel square and I trust that those that knew all about the square before will find this little condensed work of interest and handy as a reference book.

INDEX.

A

PAGE

Advice about roofs..... 119
Arch 108
Arch, centering.....107, 137
Arch, elliptical..... 137

B

Backing of hips.....63, 91, 140
Backing of octagon hips..... 63
Backing of posts..... 140
Bicycle tracks..... 130
Bicycle tracks, end rafter..... 132
Bicycle tracks, side rafter..... 132
Bicycle tracks, length of run..... 132
Bicycle tracks, bottom cut..... 133
Bicycle tracks, top cut..... 133
Bicycle tracks, top cut of braces..... 134
Board for gable valley..... 52
Board for hip..... 52
Board for valley..... 51
Board measure on blade..... 11
Board measure with square..... 13
Bottom cut of rafter..... 133
Brace measurement.....16, 17, 142, 147
Brace measurement on tongue..... 16
Brace measurement, laying off.....18, 142
Brace measurement for long braces..... 18
Brace, top cut off..... 134
Bridging 27

C

PAGE

Center pole in roof..... 79
Centering an arch.....107, 109
Centering a circle.....107, 109
Centering an ellipse..... 136
Circle 106, 107, 108, 109, 129
Circle roofs..... 78
Circle size of smaller ones..... 109
Cones divided into equal parts.....111, 113
Construction of roofs.....33, 37, 64
Courses of shingles..... 115
Curved rafters.....82, 83, 84
Cuts for braces..... 141
Cuts for braces for inclined platform... 147
Cuts for post..... 140

D

Degrees 127
Degrees and pitches..... 33
Degrees and polygons..... 78
Diagonal of one foot..... 105
Dividing into equal parts..... 27
Doubling size of squares..... 110

E

Elevation of roof.....33, 64, 96, 106
Elevation of tower..... 139
Ellipses 106, 129, 136
Ellipses, measurements for.....106, 135
Even measurements..... 127
Example in proportion..... 115

F

Facia cuts..... 72
Fence 25

PAGE
Figures on a square.....10, 11, 12, 16, 19
Finding heights of trees, etc..... 117
Finding radius.....108, 109
Foot, diagonal of..... 105
Foot measurement of common rafter.... 92
Foot measurement of hip rafter..... 93
Fractional hip measurements.....99, 100, 102
Fractional part of feet.....99, 100, 102
Frieze cut.....

G

Gable cut of boards..... 52
Gable jack rafter..... 51
Gable rafter..... 38
Gable, valley board for..... 52
Girder for tower..... 145
Gutter cut at hip..... 55
Gutter cut at valley..... 53
Gutter, side cut at hip..... 53
Gutter, side cut at valley..... 53

H

Halving tower braces..... 145
Height of tree, etc., finding..... 117
Hexagon 86
Hip backing..... 63
Hip cut of boards..... 52
Hip measurements.....99, 100, 102, 124
Hip rafter.....41, 42, 49, 60, 63, 88, 99
Hip rafter backing..... 63, 91
Hip rafter, length of..... 88, 99
Hip rafter, side cut..... 91
Hip run..... 124
Hip side cut of boards..... 53

PAGE
Hips and valleys.....39, 88, 99
Hoppers 72

I

Improved method of centering an ellipse. 136

J

Jacks 43, 47, 48, 49, 50, 51, 60, 62, 66, 94, 102
Jacks against valley..... 51
Jacks for gable.....48, 49, 51
Jacks, length against valley.....47, 48, 49
Jacks, length of..... 43
Jacks, measurements.....43, 47, 48, 49, 94, 103
Jacks, side cuts.....49, 60, 61, 62, 90
Jacks, side cuts at hips..... 49
Jacks, side cuts for uneven pitch roofs.. 66
Joists, spacing..... 20

K

Kerfing board for circle..... 119
Knotty problems easily solved.....84, 111, 136

L

Laying off rafters.....31, 121, 123, 124, 125
Laying off stair..... 26
Laying off studding..... 20
Laying off studding with one-foot tongue 23, 25
Laying out octagon.....13, 125
Laying out star..... 149
Laying out trestles..... 27, 30
Length of braces.....17, 18, 142, 145, 148, 147
Length of braces for roof..... 147
Length of gable rafters..... 38
Length of hip..... 42

PAGE

Length of jack..... 43
Length of main rafters.....37, 123
Length of posts..... 139
Length of valley..... 40
Lumber measure..... 11, 13
Lumber, price found with square..... 115

M

Main rafter.....30, 31, 37, 87
Measuring across a stream..... 119
Measuring with slotted square..... 23
Measurement for ellipse..... 136
Measurement for hip..... 124
Measurement for jack..... 102
Measurement for oval..... 32
Mitering mouldings..... 72

N

New methods..... 7

O

Octagon backing..... 63
Octagon jack, side cut..... 62
Octagon, laying out with square.....13, 15, 125
Octagon measurements.....13, 126
Octagon on tongue..... 13
Octagon rafters..... 79, 88
Octagon rafters at top..... 79
Octagon roofs..... 79
Octagon scale..... 13
Octagon side cut..... 61
Ogee rafters..... 83, 84
Ovals 32, 129

P

PAGE

Pipe through roof..... 106
Pitch, uneven.....33, 64, 74
Pitches 33, 34, 36, 37
Pitches, co- and complement.....37, 57, 58
Plan of hips.....57, 78, 79, 102
Plan of roof.....33, 35, 64, 97
Plan of square roof and circle tower.... 97
Plumb cut..... 134
Pole in center of roof..... 79
Polygons 77, 78, 148
Posts 139, 142
Posts, backing..... 140
Posts, cut at end..... 140
Proportion 100, 102, 109, 110, 114, 116, 118

R

Radius, finding.....108, 109
Rafter 30, 121
Rafter against center pole..... 79
Rafter bottom cut..... 133
Rafter, circular..... 82
Rafter construction..... 74, 79
Rafter for bicycle track at end..... 132
Rafter for bicycle track at side..... 130
Rafter for gable..... 38
Rafter for octagon and circle roofs..... 78
Rafter for tower roofs..... 84, 87
Rafter, jacks..... 94
Rafter, jacks for gables..... 51
Rafter, jacks measurements....19, 43, 47, 48, 49
Rafter, jacks of different spacing..... 94
Rafter, jacks run.....47, 48, 49
Rafter, jacks run at valley..... 49

PAGE
Rafter, jacks side cut.....49, 51, 90
Rafter, jacks side cut at hip..... 49
Rafter, jacks side cut at valley..... 51
Rafter, lapping on roof..... 74, 76
Rafter, laying out..... 97, 99
Rafter, length of gable..... 38
Rafter, length of hip..... 99
Rafter, length of jack.....43, 48, 94, 102
Rafter, length of main..... 97
Rafter, length of octagon..... 99
Rafter, length of valley..... 40
Rafter measurements,
18, 30, 31, 37, 38, 40, 42, 46, 48, 89
Rafter measurements at bottom..... 92, 93
Rafter measurements at top..... 89
Rafter measurements at valley and hip.39, 93, 99
Rafter, ogee..... 83, 84
Rafter, pitches.....34, 36, 37, 64
Rafter plan.....33, 64, 74, 79
Rafter plumb cut..... 133
Rafter, rise and run..... 30
Rafter, top cut..... 133
Rafter, uneven pitch..... 70
Reducing with square..... 114
Rise 30
Roof framing, rapid..... 120
Roof plan.....33, 35, 64, 97
Roof, construction of.....33, 37, 64
Run 30
Run of hip.....41, 104
Run of jack..... 49
Run of post..... 139
Run of rafter..... 132
Run of valley..... 39

S

PAGE

Shed roof and braces..... 139
Shingles for roof..... 115
Side cut of girder..... 145
Side cut of gutter..... 54, 55
Side cut of hip..... 53, 60
Side cut of jack.....49, 50, 51, 60, 90
Side cut of jack for uneven pitch roof.. 66
Side cut of octagon..... 61
Side cut of octagon jack..... 62
Side cut of valley..... 52, 60
Spacing joists and studding..... 20, 22
Spacing with slotted square..... 22, 24
Spacing with one foot tongue..... 23, 25
Square, small..... 10
Square with 16 and 18-inch tongues.... 23, 25
Square with slot..... 22
Stair 26
Star 149
Steel square possibilities..... 148
Studding, spacing..... 20

T

Tangent run and pitch..... 57, 58
Top cut of brace..... 134
Top of rafter.....89, 133, 135
Top side cut of uneven valley..... 70, 71
Tower braces at bottom..... 141
Tower braces, length.....141, 144, 145
Tower braces at top..... 145
Tower braces for water tanks..... 139
Tower roofs..... 79, 96
Tree, finding height..... 117
Trestle 27, 30

U

PAGE

Uneven pitch roof plan..... 33, 35
Uneven pitch roof valley..... 74

V

Valley board..... 51
Valley board of gable..... 52
Valley construction..... 37, 64
Valley cut of facia..... 72
Valley cut of gable..... 53
Valley cut of gutter..... 53
Valley length..... 40
Valley of uneven pitch roof..... 33, 64
Valley plan.....35, 65, 75
Valley run..... 39, 40
Valley side cut..... 52, 60
Valley side cut of board..... 52
Valley side cut of board at gable..... 53
Valley side cut of gutter..... 54

W

Water tank, tower for..... 139

BOOKS FOR CARPENTERS

We will be pleased to send our catalogue of books to any address. Also send for a free sample copy of

WOODWORKERS REVIEW

a monthly paper for carpenters who desire to be posted on new methods of work and the principles of carpentry. Subscription price 50 cents a year; each issue contains about 32 pages, 9 x 12 inches. Carefully edited, practical and finely illustrated.

Industrial Publication Co.

16 Thomas St. **New York**